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More About the Coast Survey

HASTY editorial arithmetic was responsible for an inaccuracy in the note entitled "Coast Survey's Practical Work" on page 545 of the Engineering Record for May 16. It was there stated that the level net described in a recent publication comprises more than 2000 determinations. This is correct only by courtesy, as there are really more than 10,000. This unintentional injustice affords an opportunity to elaborate still further on the value of the data reported. While the elevations as given to three decimal places in feet and meters may not remain absolutely correct when referred to sea-level datum, the important fact is that each elevation has the correct relation to any other in the system. It should lend confidence to engineers who, for instance, are engaged in establishing sewerage or water supply systems to be able to start from some Coast Survey bench-mark, run several miles of levels and check on another, knowing that the interval has been accurately measured.

Code of Ethics Adopted

THE Baltimore convention of the American Society of Civil Engineers approved the code of ethics presented by the board of direction, and passed it on for final adoption by letter ballot. If the sentiment at the convention is a criterion the code should prevail by an overwhelming majority. Several efforts were made to amend the document, but these, happily, were unsuccessful. Had they succeeded there is no guessing at the limit to which the code might have been amplified. However, only the first step has been taken. As it now stands it is merely a declaration of principles, a law without either penalty for its violation or machinery for its enforcement —which is an absurdity from the legal standpoint. And this statement is made in full realization that the constitution does provide for the expulsion and disciplining of members. But those provisions are woefully inadequate, as has been demonstrated by a flagrant case now in the hands of the board of direction. The proper provisions need not be placed in the code itself; indeed, that might be inadvisable, for the code is a text and a declaration to be paraded for the benefit of its moral influence. Nevertheless it needs teeth, even though they may well be kept in the background—in the constitution of the society.

Confederation of Engineering Societies

THE profession generally, no less than the members of the American Society of Civil Engineers, will be interested in the presidential address delivered by Mr. McDonald in Baltimore last week. He takes up not only the problems of the society but the status of the entire profession in this country, and advocates a confederation of engineering bodies. It is surprising that confederation or some co-operative scheme receives so little consideration. The need of it grows more evident every year, as is shown by the existence of the joint committee which has been endeavoring to draft a licensing bill. A plan for co-operation, on a more limited scale however, was proposed before the American Institute of Electrical Engineers about a year ago, but the scant recognition it received from other societies is characteristic of their attitude toward each other. Mr. McDonald is right in emphasizing its importance. When the power of the 24,000 members of the Verein Deutscher Ingenieure is considered, one longs for the day when the puerile jealousies and unbending pride of our National societies will disappear and co-operation be substituted for criticism.

Flood Data Needed

TECHNICAL committees of the great engineering societies in many cases progress only at a snail's pace. The action, therefore, of the special committee on flood prevention of the American Society of Civil Engineers in presenting at Baltimore last week a progress report, within six months of its appointment, is to be commended. True, the report is not exhaustive. It does, however, state the conditions with reference to the collection of data on which a report must be based. And this, be it emphasized, is most important now, when there is much agitation for the construction of flood prevention works. One might think that there were a panacea immediately available. The committee's report, insisting on a period of investigation, is most timely, and should be brought to the attention of Congress, before which at present are a number of bills for flood prevention appropriations. What is needed now is not money for construction but for investigation, in order that the data which the committee points out as missing may be obtained.

Engineering Service for Small Towns

MUNICIPAL and sanitary engineering service is being offered to communities in Wisconsin in accordance with a plan recently inaugurated by the extension division of the State university. The object is to correct improper methods of water supply, sewerage and garbage disposal and to better sanitary conditions generally in small towns. Opportunities for service will not be solicited by the extension division, but requests for advice will receive the fullest consideration possible. The work is in charge of a municipal and sanitary engineer, who will be free to call upon the various university departments and upon consulting engineers in private practice for assistance and co-operation. In this manner it is hoped that the best advice may be obtained, and unbiased, honest opinions presented. The general scope of this service will be in the form of advice to communities and individuals and will be limited to a "preliminary survey." Finished plans and specifications will not be submitted. If the village officials decide to go ahead with the plan, a consulting engineer in private practice must be employed by them to work out details and supervise the construction. Under the present system the small village is not reached by the sanitary engineer. Consequently the service should be beneficial not only to the communities but also to engineers in private practice.

Federal Control Over Rates

IN the Minnesota rate case decision the United States Supreme Court declared that the State Legislature might fix intrastate rates so long as they were not confiscatory, but that Congress had authority to direct the fixing of these rates because of their influence on interstate rates. The court held, further, that until Congress exercised that authority the State legislatures were free to act. Now, however, the status of the matter is more clearly defined. On Monday of this week the Court handed down its decision in the Shreveport case. It strikes from the railroads the bondage of the States so far as rate-making is concerned, holding that the Interstate Commerce Commission is the agent of Congress and that if it rules on rates where intrastate rate influence is involved, Congress has thereby exercised the authority which the Minnesota decision declared was vested in it. In the Minnesota case no ruling of the commission was involved. The States no longer have the right to fix rates for traffic wholly within their boundaries, if these rates discriminate against interstate commerce. The decision naturally is welcomed by the railroads. Instead of having to submit to forty or more masters, in the shape of State commissions, they will look now exclusively to one—the Federal commission. The decision very considerably strengthens the control of that body.

Future of the Automobile

PREDICTIONS upon engineering matters by so eminent an electrical authority as Dr. Charles P. Steinmetz command high respect, and the views advanced by him at the recent convention of the National Electric Light Association regarding the future of the automobile have attracted widespread interest. In a nutshell, Dr. Steinmetz believes that the automobile as a pleasure-giving device is passing through the same cycle as did the bicycle, before it settled down as a sober means of business conveyance. According to Dr. Steinmetz, the large gasoline-driven touring car, manned by an expert chauffeur-mechanic, and the electrically driven roadster, coupé and truck are to handle the private motor-vehicle transportation requirements of the next decade. In his Philadelphia address upon the electric vehicle, the speaker said that inside of ten years at least a million electric automobiles, costing not over $500 each and weighing not in excess of 1000 lb., with a mileage per charge of at least 30, a maximum speed of 20 miles per hour, and a maintenance cost of $10 per month each, will be in service, the steam-driven automobile will have disappeared and the gasoline roadster and town car will have succumbed to the simplicity and economy of the electric. Be this as it may, Dr. Steinmetz made an exceedingly important point in demonstrating that neither high-speed nor extra long mileage are needed for the great proportion of automobile travel and commercial service, and he unquestionably hit the nail on the head in setting forth the diminishing enthusiasm of the gasoline-car owner for practising the technique of repairs in a sport which is rapidly losing its exclusiveness. If the type of car he described makes its appearance within a year or two, there is no question that if the electric service companies provide the necessary charging facilities, the gasoline motor-vehicle manufacturer will have to do some pretty energetic development work to keep in the running.

Labor Exempt from Sherman Law

NOT a vote was cast in the House of Representatives on June 1 against the proposal to exempt "fraternal, labor, consumers, agricultural or horticultural organizations, orders or associations" from liability to prosecution under the anti-trust laws. In order to make assurance doubly sure, this paragraph was added to the original exemption clause: "Nor shall any such organizations, orders, associations, or the members thereof, be held or construed to be illegal combinations or conspiracies in restraint of trade." According to the Washington correspondents, the representatives of organized labor say that this exempts them from prosecution of any kind under anti-trust acts, but that the administration leaders deny this. On what this denial is based is a mystery, for the language of section 7 of the Clayton bill, as adopted last week, seems unmistakable. Equally certain does it appear that we now have a "favored class" in the United States. It is not composed of the plutocrats, the highly born, or the malefactors of great wealth, but of the members of trades unions. They are the ones who demanded this legislation and succeeded in scaring every member of Congress present at the session of June 1 into voting for it. The farmers, fraternalists and others were simply put in for good measure. According to the "Weekly News Letter" of the American Federation of Labor, the exemption clause is only a beginning. Under big headlines it says: "Victory is in sight. Labor to be freed from anti-trust laws, injunction abuse and unjust contempts." In some quarters the exemption clause is held to be very mild and a mere sop to labor. This is a poor defense, indeed, for the House, and an admission that that presumably august body has not the backbone to stand by its convictions. In any event, the legislation stands condemned when judged by all fair standards.

Proposed New Orleans Bridge

THE plan to bridge the Mississippi River at New Orleans, described on page 683, is of importance on account of the commercial influence of the structure and the engineering difficulties involved, while technical interest centers in the opportunity it gives for comparing the design made several years ago for a span then almost unprecedented with bridges of greater span that have since been built.

At present the Mississippi River is not bridged below Memphis, 721 miles above New Orleans, and the proposed structure would be of great importance especially to the four railroads approaching the city from the west and north. The expense and delay of delivering commodities across the river at this point and the commercial interests of the State of Louisiana are so great, that the proposed legislative act to authorize the structure goes to the unusual extent of making the bridge business an exclusive monopoly by the prohibition of car transfer by ferries or barges. It also provides immunity from taxation and guarantees the bridge company's bonds for the full estimated cost.

Like most of the Mississippi River bridges the foundations for the main piers present considerable difficulty on account of the depth of the water, about 100 ft., and the character of the bottom. The bed of the river consists of loam and sand to a depth of 1000 ft. or more, through which it is proposed to sink dredged caissons to about 70 ft. below the bottom—until the combined bearing power of the soil and the frictional resistance on the piers suffice for the load supported. The sinking of piers to so great a depth is likely to develop valuable information concerning the efficiency of the process and perhaps its limits.

In consequence of the radical development and changes in type of construction and details for very long spans, as exemplified in the Quebec, St. Louis, Memphis, and New York bridges, built since the preparation of the design for this structure, it is to be expected that the design will be materially revised. The results can not fail to be of great interest.

"Fire Resistive" vs. "Fireproof"

AT the convention of the National Fire Protection Association in Chicago last month the committee on "fire-resistive" construction proposed the term in its title as a substitute for the common but discredited term "fireproof." This is the revival of a proposal made, and temporarily rejected, some years ago, the argument for rejection then being that the term fireproof was fairly well understood to mean resistive to fire rather than proof against damage by fire. It is apparent, however, from the scoffing that one hears when a "fireproof" building is severely damaged that the term is not well understood and that the time for a change is at hand. The report is now before the executive committee of the association and early action is to be expected.

The Chicago report recommends that the new term be applied "to all structures or materials which will satisfactorily resist the effects of a serious fire," in accordance, however, with a classification as to what constitutes satisfactory resistance. This supplementary classification divides "fire-resistive" structures and materials into those that give full protection, partial protection and temporary protection. The first implies resistance to a severe fire for four hours; the second, resistance for two hours, and the third, for at least one hour. In other words, what is now termed "fireproof" construction is not such. At best it is only "fire resistive," and gives protection for a limited time only, the best material or construction being expected, as a standard, to survive only four hours. To make its definitions complete, the committee further particularizes for the three classes of protection as to the degree of heat, the area to be tested, and the minimum time for application of water after heating. These definitions are to be amplified for structural members by specifying the loads to be carried. At present the only qualifications are that the load applied after the fire shall be four times that during the fire and that for "full protection" floor slabs shall carry 150 lb. per square foot during fire. A definition therefore, logical in itself is to be supported further by definite specifications. It is to be hoped that the executive body of the association will approve the committee's findings, and if the standing of the committee itself is any criterion favorable action is to be anticipated.

Features of Salmon Falls Hydro-electric Development

THE Salmon Falls power development described on page 671 is notable because of the regulation of a water column 9625 ft. long, and the installation of four needle valves 8 ft. in diameter. Certain other features warrant more than passing attention.

To absorb the energy of the water in the long pipe line a differential surge tank 205 ft. high had to be installed. The use of a plain cylindrical standpipe would have been prohibitive, first because of the stresses in the lower part and, second, because of the height required to prevent spilling. Although the differential tank lends itself admirably for the absorption of the energy of the water the designer has provided by-passes at the turbines so as not to put the burden of the entire regulation on the tank. As the station is tied into the Niagara, Lockport & Ontario Power Company's system regulation has to be taken care of only through a small range. Had the plant been built to operate independently neither pipe line nor surge tank would probably have been used. In such a case an open flume or canal, with a large forebay at the head of the penstocks, would have been better. With that arrangement, however, it would have been practically impossible to prevent loss of water, a matter of considerable moment at this station.

The needle valves are of special interest, since they have been tested under service conditions for several years at Niagara Falls, in the Ontario Power Company's station. The valves there, however, are 9 ft. in diameter, while those at Salmon Falls are 8 ft. in diameter.

Question might be raised as to the advisability of placing the tailrace in a tunnel through the powerhouse substructure. Consideration of the volume of discharge and the velocity of the water indicate that severe erosion may occur, while, further, the eddies formed with three wheels running will probably be so strong that the entire tunnel section will likely be filled with water and possibly be put under pressure. This would mean a loss of head on the turbines.

Another point of interest is that this station is peculiarly well adapted for pumping water back to the reservoir with power from Niagara Falls. As it was built mainly to take care of peak loads on the system, it will be shut down during hours of low load. As the plants at Niagara are permitted to take their water allotment at all hours, the surplus power during low loads could be transmitted to Salmon Falls and used for pumping water back into the reservoir. Of course, such pumping would only be necessary at times of low flow in the Salmon River. This scheme has been used in several instances in Europe. In one case, for a low-head development, water is pumped to a reservoir located over 1500 ft. up on the hillside, and is used later in the day in taking care of the peak load on the station. Insufficient storage facilities necessitated this arrangement, which enables the station to take care of a peak load nearly twice that otherwise possible.

Confusion in Paving Specifications

IN 1908 there appeared in the Engineering Record an article on "Hysteria in Regard to Pavements." It seems now that the disease has grown, and instead of being a mild manifestation of a general physiological condition it has assumed many of the symptoms of neurasthenia, the prevailing American ailment. This applies particularly to the question of specifications for bituminous materials for street and road construction. A single phase of the question will suffice to show how confusing are present conditions.

Determination of the volatile matter in bitumens was originally made as a control upon formerly-used types of flux which at best were not too good. In the later development of the industry the characteristics which fluxes should have became better known, and while it is still desirable and necessary from time to time to check the amount of volatile matter in them, this same test has been and is now being applied to the asphaltic materials both before and after the addition of the flux. In the many and rapid changes that are taking place in specification requirements to-day the details for determining the volatile matter in an asphalt have been so distorted that there is cause to wonder how any producer can foretell whether a product acceptable to-day will be rejected to-morrow.

At first the test was made in a glass dish, common to nearly all laboratories. This was soon abandoned as being too fragile and a tin box of approximately the same depth and diameter, both controlling factors, was substituted, but the directions are very explicit as to the size. This is one requirement: "In a dish 2¼ in. in diameter by 1 5/16 in. high are placed 20 grams. Should it be necessary to use a very much larger dish, the weight of the material to be taken should be calculated so that the volume which it holds shall bear the same relation to the surface exposed as in the case of the smaller dish."

If any one has access to paving specifications from various localities, and will take the time to compare the volatilization requirement, he will find specified boxes ranging in size from 1¾ to 2½ in. in diameter, and ⅞ of an inch to 2 in. in depth, all the sizes requiring twenty-gram samples. In some instances the size of the sample has been increased to fifty grams, but this is not general.

When one stops to consider that the recommended method of the Association for Standardizing Paving Specifications adopted at its meeting in Pittsburgh, February, 1913, is for fifty grams in a 2¼ in. dish, while the standard specifications adopted in 1911 and 1912 by the American Society for Municipal Improvements prescribes a 2½-in. dish without any definite amount for test, it will be realized that the prevailing confusion is due in part at least to this difference of opinion between the two societies.

It is to be hoped that since these two organizations are now one, they as well as other societies interested will appreciate the influence their specifications have upon various municipalities, and endeavor to make them as nearly uniform as possible, in method at least, if not in requirements. Most of the work along these lines has been done under the old standards, and for results to be comparable the same conditions of test should prevail.

Maintaining a Record for Industrial Foresight

THE report of the public policy committee of the National Electric Light Association at last week's Philadelphia convention included suggestive references to industrial education, safety work, industrial insurance, employees' savings and investment methods. The liberal point of view of the association with reference to these topics is well known, and it is gratifying to observe that experience with the policies, which may be said to have been fairly launched at the New York convention of 1911, leads to the single conclusion that such work is emphatically worth while from every standpoint. There is no doubt that the efforts which the member companies are making to safeguard their employees' health, to teach accident prevention, to provide means for personal advancement through special study, and to insure adequate compensation with due regard to the necessities of age are building up a vast body of loyal workers within the electric-service industry. There are, in addition, benefits to the companies themselves through increased efficiency among their employees, reduced outlays on account of injuries, and a sympathetic and appreciative public opinion.

The report recommends that wherever practicable continuation schools be conducted by the member companies; that the attendance be on the employers' and not on the employees' time, and that the courses be not only broad but specific. The point is well made that attendance at evening schools is accompanied in many instances by severe mental and physical fatigue after the regular day's work, and that the training of such institutions, when received, is insufficiently direct to result in the most efficient service to the employer.

As for safety work, the committee appreciates that it is no longer confined to any particular industry. The effectiveness of such education is being constantly demonstrated. Thus, the Department of Labor of the National Government reports that where organized safety and sanitation departments exist, two out of three accidents are prevented. The elimination of danger spots within plants and the safeguarding of the worker on the distribution system are proceeding hand in hand; conspicuous progress has been made of late in providing better equipment even for such hazardous occupations as those of the lineman and cableman.

Some of the larger insurance companies have either adopted or are about to put into effect policies insuring employees in groups, at a class rate based upon their average age and without the usual physical examination. Likewise, group accident and sickness insurance may be obtained from some of the larger companies at special rates.

One phase of employee relationship highly commends itself to the signers of the report, namely, the establishment of saving systems whereby employees are aided in the purchase of their homes and of the securities of the company by which they are employed. The advantages of developing employees in sympathy with the problems of the property owner, and dependent as investors upon their own efforts, are obvious.

It is evident, therefore, that the association is maintaining the great record it made for itself in its first great public-policy report. Such work holds out hope of betterment of conditions of labor and may well be commended to students of industrial economics for earnest consideration.

Pile-Casting Yard, with Traveling Cableway Tower in Background

Large Reinforced-Concrete Pier at Halifax

Use of 24-Inch Piles 75 Feet Long, Made of Special Cement to Resist Chemical Action; Brace Piles Cambered to Neutralize Stresses

EMPLOYMENT of 24-in. piles 75 ft. long, with a specially designed pile driver to place them; use of a special cement with a minimum of alumina to resist the chemical action of sea water and a timber sheathing at the water line to protect the concrete from frost action; the casting of the diagonal brace piles with a camber of from 2 to 5½ in. to allow for the bending moment of the pile's own weight—these are among the features of the new pier 2 under construction for the Intercolonial Railway at Halifax, N. S.

GENERAL FEATURES

The pier, which when completed will be 686 ft. long and 235 ft. wide, and will carry a shed 677 x 198½ ft., is the first of a series of four large piers proposed to replace four much smaller ones. The general plan shows the relative location of the old and new piers and their track connections. By this plan piers 2, 4 and 5 would be removed and pier 3 would be lengthened and widened to form the new pier 3. Work on pier 2 was started in the fall of 1911, and when the 1913 season had closed all but 120 ft. of the pier had been built and a start had been made on the shed. The shed will be a two-story structure, the lower floor being devoted to cargo and mail. The upper floor will be fitted up and used for a time for passengers and baggage, with the intention of subsequently changing it for freight use only.

Reinforced-concrete piles were selected as most suitable for the foundations. Borings showed solid rock at a depth varying from 52 to 68 ft., overlaid with from 2 to 12 ft. of hardpan and from 5 to 27 ft. of soft mud. This meant an average height of 75 ft. from rock to track level. The track level was fixed at 15 ft. 8 in. above extreme low water. Owing to the small height available above low water for diagonal transverse bracing, and the great depth from low water down to rock, it was thought that such a system of bracing would not greatly increase the stability of the pier and its ability to withstand shocks from vessels. It was, therefore, decided to use reinforced-concrete brace piles driven at an angle of 3 on 1. This is believed to be the first application of such a system of bracing to reinforced-concrete work. As a further means of stiffening the pier it was decided to make a bank of dredged material under the pier so as to increase the amount of material through which the piles would be driven.

SPECIAL CEMENT

Two causes militate against permanency of concrete in salt water in this latitude. One of these is frost action, the water absorbed by the concrete at high tide freezing at low tide and causing the surface to spall away between the tide levels. The other is chemical action, which takes place between certain salts, notably magnesium sulphate, and constituents of the cement. Investigations have shown that this magnesium sulphate reacts with the free lime liberated during the setting of the Portland cement to form calcium sulphate, which in turn reacts with the calcium aluminate of the cement to form a sulpho-aluminate of lime. This last substance swells considerably on hydration, thus disintegrating the concrete, and it is evident that the extent of the disintegration varies directly with the alumina present in the cement.

To resist this chemical action arrangements were made with the cement manufacturers to supply cement with a maximum of 6.3 per cent of alumina, which was the lowest they could produce. It was also decided to use proportions of 1:1½:3, so graded as to produce as dense and nonporous a concrete as possible.

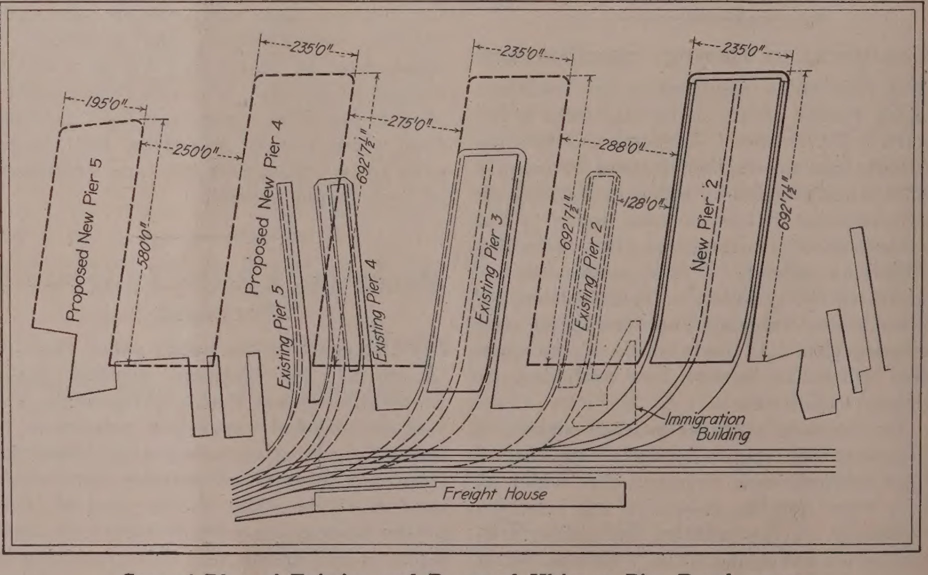
To withstand frost action it was decided to sheathe all concrete within the ordinary tidal range with timber. In order that this timber might be durable it is creosoted, and to prevent chemical action between the creosote and the cement the surfaces of the planks are coated with pitch.

LOADING

Live loads of 1000 and 500 lb. per square foot for the first and second floors respectively were assumed in working out the details of design. The spacing of the piles was determined by the spacing of the shed column, which in turn governed the load for each pile to carry. As the drawings show, the transverse spacing of the columns is 39 ft. 6 in.; the longitudinal spacing of bents is 18 ft. Three vertical piles and one brace pile carry each interior column and single intermediate piles carry the floor. This arrangement gives a distributed load of 80 or 90 tons per pile. To keep the load on the rock well within a maximum of 35 tons per square foot the size of piles was fixed at 24 in. square.

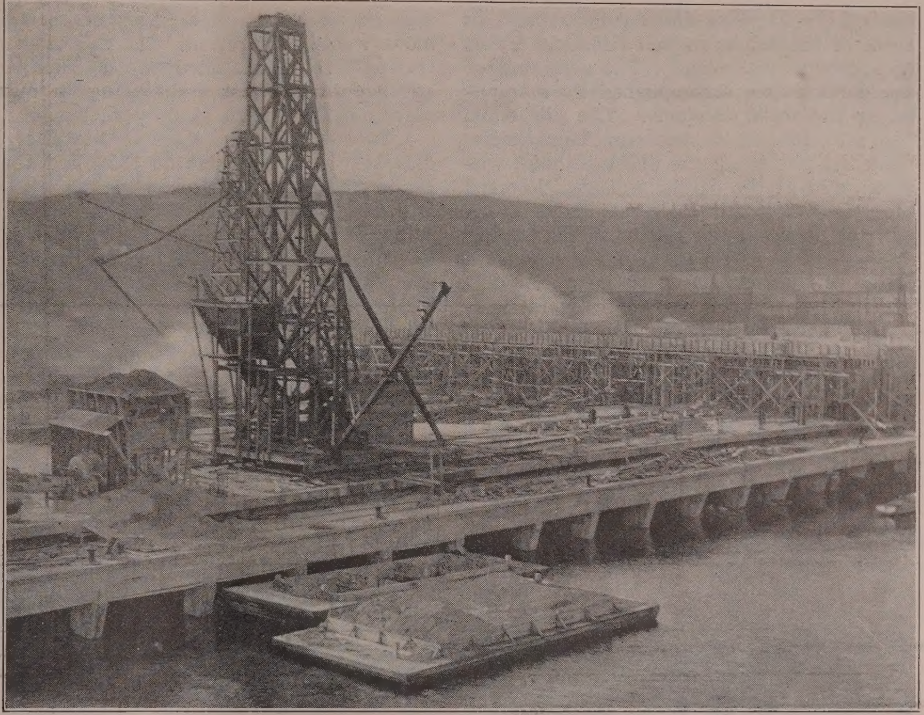
Eight round rods, from 1 to 1¼ in. in diameter, according to the length of the pile, and laced every 12 in. with ¼-in. rods, form the reinforcing. This lacing is spaced closer at the heads of the piles, and at the tapered points additional rods and spiral hooping are used. The points are 3 in. square and are not shod. To facilitate bonding with the decks the rods are allowed to project 3 ft. beyond the head of the pile, and in each pile there is also set a staple, made from a 1¼-in. square bar 7 ft. long, to aid in handling.

Similar reinforcement is used in the brace piles, but in order that when the pile is built into the pier and subjected to an axial compressive load of 80 tons the stresses due to this load and the bending moment of the pile's own weight may be uniform it is cast with a slight camber. The amount of this camber varies from 2



General Plan of Existing and Proposed Ultimate Pier Development in. for 45-ft. piles to nearly 5½ in. for the longest, which are 77 ft. The brace piles are driven in such positions that their heads can be built up along with the vertical piles under each shed column. In this way the full value of the pile is thought to be obtained without danger of its breaking up the decks.

The general scheme of design of the shed is shown in the details. A feature is the use of expansion joints in the roof. Owing to the fact that only a part of the second floor will require heat, while the entire first floor and the baggage spaces which occupy the outer bays on each side of the upper floor for about five-sevenths of its length will not be heated, it was found necessary to provide these expansion joints to relieve the stresses that would be set up in the columns by the unequal heating of the building. Seven transverse joints are provided, 90 ft. on centers. They extend over the interior bays only, and are formed simply by cutting the slab and leaving a ½-in. space, the longitudinal beams thus cut being designed as cantilevers on each side of the joint. A ½-in. steel plate laid horizontally and bedded into grooves in the adjacent edges of the slabs at each joint secures their alignment.



Part of Completed Deck; Construction Under Way on Shed

When the contract was let in September, 1911, work was at once started on the removal of the old piers occupying the site. This took all of the following winter, a diver being required to help remove many of the limnoria-eaten stumps of wooden piles. It might be mentioned that even creosote does not seem to be entirely effective in these waters, as piles treated with this preservative and driven about four years ago showed signs of attack.

PILE-CASTING YARD

Meanwhile preparations were being made for casting the piles. At the east end of an area 800 x 600 ft. graded level for the purpose a gravel-excavating and concrete-mixing tower was erected. On this tower, which was about 92 ft. high and was carried on wheels so that it could travel north and south across the end of the yard, was placed the machinery for excavating, screening and crushing the gravel, mixing the concrete and conveying it by a cableway to the pile molds. At the top of the tower was a winch which operated a dragline bucket. This bucket emptied its contents of sand and gravel into the hopper. The material passed over a grizzly and all stones that did not pass through were conveyed to a jaw crusher. All of the material then went over 1-in. and ¼-in. screens. Material passing through the ¼-in. screen went into the separate sand bin. That which did not pass through the 1-in. screen was taken to a second crusher. Chutes from the sand and stone bins led to the mixer platform, wherein each batch was measured before being put into the mixer. Each batch of about 1 cu. yd. was discharged by means of a chute into a bottom-dump bucket which traveled along a cable stretched from the mixer tower to an anchor tower at the west end of the yard. This tower was also mounted on wheels and tracks and was moved along with the main tower.

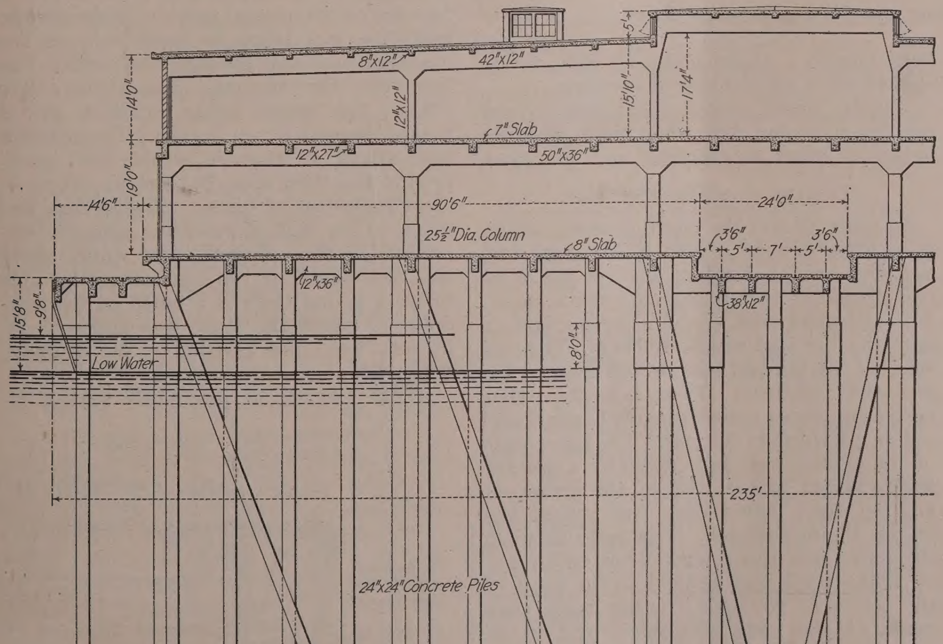
A timber pier 1000 ft. long and 22 ft. wide, increasing in width to 38 ft. for 85 ft. at its outer end, was built for the landing of supplies and the shipping of the concrete piles. A 30-ton steam derrick at the outer end of the pier loads the piles on scows.

The pile yard was divided into ten subyards running north and south. The piles were cast, usually in pairs, with the axes east and west, parallel to the cableway. Transverse tracks ran between the piles and a longitudinal track ran the length of the yard on the outside. A locomotive crane handled the piles between the yard and cars on the transverse tracks, another transferred them to the longitudinal track, and the 30-ton steam derrick above mentioned disposed of them at the outer end of the pier. In handling these piles they were always supported one-fifth of the distance from each end.

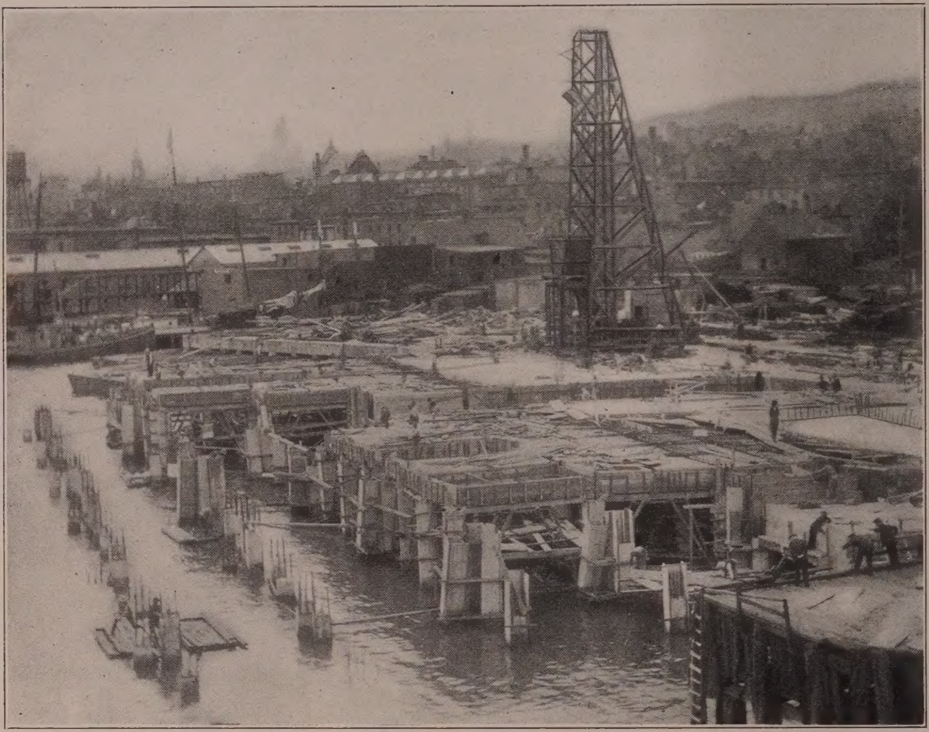
Simultaneously with these operations a special pile driver to place the piles was being designed and built. This outfit was described in the Engineering Record of May 30, page 612. It took longer than was anticipated to build and fit up this pile driver, and it was not until January, 1913, that everything was in readiness for driving the piles.

PLACING AND DRIVING PILES

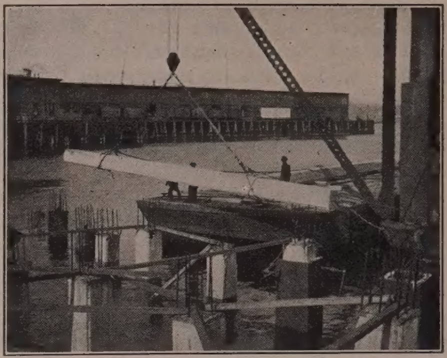
The method of placing and driving a pile was as follows: The driver was first placed in correct position by means of cross-ranges, and the three spuds were lowered to anchorage. The pile having been brought with others alongside on scows, straps were placed around it at points one-fifth of the distance from each end, and the pile was lifted in a horizontal position by



Transverse Half-Section of Pier and Arrangement of Batter Piles



Completing Piles above Water Line and Placing Concrete Deck



Handling a 75-Foot Pile with a Derrick

one of the derricks and swung around in front of the driver so that the head lay at the bottom of the lead. The swinging of the derrick was accomplished by manipulating the forward spuds. The pile cable being made fast to the staple projecting from the pile head, the order to hoist was given, and as the derrick fall was lowered the pile was gradually hoisted into a vertical position, the derrick straps being disengaged as they slackened off. The leaders were then moved until the pile, hanging in them, was centered in exact position. Then the pile was lowered, its own weight being sufficient to penetrate the soft mud overlying the hardpan. When the thickness of the mud was equal to about a third of the length of the pile it was found that the piles would stand where placed without any bracing; as a rule, however, the pile was braced while the hammer was being adjusted on its head.

Three separate cushions were used between the concrete of the pile and the ram of the hammer. On top of the pile was placed a 3-in. spruce plank. On this rested a cast-steel follower about 4 ft. high consisting of a hollow cylinder or post with top and bottom flanges. The bottom flange was flat, and in it were eight holes through which the projecting rods of the pile reinforcement passed and were protected. The top flange had cast on its upper side a rectangular depression in which was placed a hardwood block about 15 in. thick, bound round with a steel band. This block received the direct blows of the hammer and had to be frequently renewed; sometimes it would last for two piles only, while at other times it would stand the hammering of twenty. Usually the cause of failure was the breaking of the steel bands, but on one occasion the block was found to be on fire and badly charred owing to the heat generated by the force of the blows.

There were great differences in the amount of driving required. Where the quantity of hardpan was small the pile would often come to a stop after 200 or 300 strokes, while at other places nearly 1800 blows would be required. The rate of penetration through the hardpan was small, the advance in the last strip being in many cases not more than ¼ in. per blow.

Little damage was done to the piles in driving. Only two out of 1550 had their heads smashed, and these were among the first dozen driven, the cause being a continuation of the hammering after the pile had reached rock. No harm was done, however, by a few blows after the penetration had stopped. In order to find out what was happening to the point of the piles some of them were pulled out after having been driven to refusal. In only one case was there any damage done to the point, and this damage is believed to have been due to a sharp point of rock, which spalled off a small piece of concrete.

Usually about twelve piles were driven per ten-hour day, but when there were no delays as many as eighteen were placed.

TESTING THE DRIVEN PILES

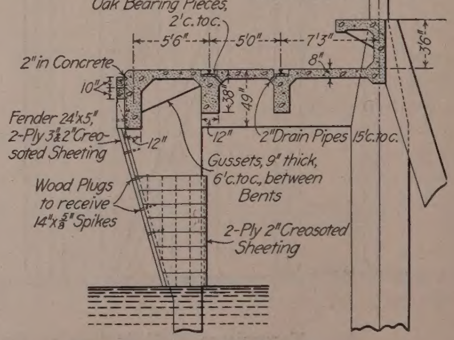
In order to test the bearing power of the piles after driving a load of 120 tons was supplied on the head of one of the piles and allowed to remain there for three hours. No settlement took place. The method of applying the load was as follows: The pile selected for the test was driven close to the cribwork bulkhead. Two 12 x 12-in. timbers were placed across the pile heads, bearing on a hardwood fulcrum. The inner ends of the timber were held down by a bracket firmly bolted to the base of the cribwork, and on their outer ends was placed the 16-ton steam hammer. The ratio between the outer and inner lever arms being 6½ to 1, the total load applied to the head of the pile was 120 tons. Other tests were made as the work proceeded, and in no case has any settlement of a pile been detected.

To get forms of the necessary strength on the short lengths of piles projecting above the water level, 4 x 8-in. horizontal walings were bolted on each side of the pile as soon after driving as possible, and on these rested the vertical forms for the building up of the pile to deck level. The bottom planks of the beams were carried on the pile extension forms and were further supported by diagonal shores from the walings on the piles. Slight settlement of the forms took place on the pouring of the deck concrete, but in no case did any serious failure occur. It was found that by filling the pile extension molds at least twenty-four hours ahead of the pouring of the deck the settlement in the forms was reduced considerably.

DECK JOINTS

It was impossible to concrete such a large area of deck without having joints between different days' work. No joints, however, were allowed between beams and slabs. The beams having been designed as T-beams, the slab was always poured immediately after the filling of the beam supporting it. The joints at the end of a day's work were arranged so that the vertical face so made would be perpendicular to the compressive forces in the beam or slab at the joint, and they were made where the shearing stresses were a minimum. In the case of the longitudinal girders the joint had to be made at one side of the floorbeam carried by the girder, at a point where shearing stresses would occur. The joint here was made with a horizontal berm to give a bearing to the central portion of the girder, and care was taken to have some of the diagonal rods pass through the joints. For the deck the concrete proportions were 1:2:4, the stone being crushed gravel passed through a 1-in. screen. The concrete was mixed so that it would flow easily around the steel rods, but not so wet as to show an excess of water. Special care was taken to see that all steel was properly embedded in the concrete, and where there was any doubt of the concrete being able to work round the rod a batch of fine concrete, in which the stone was under ¼ in. in size, was used instead of the ordinary mixture.

About 120 ft., as previously stated, re-

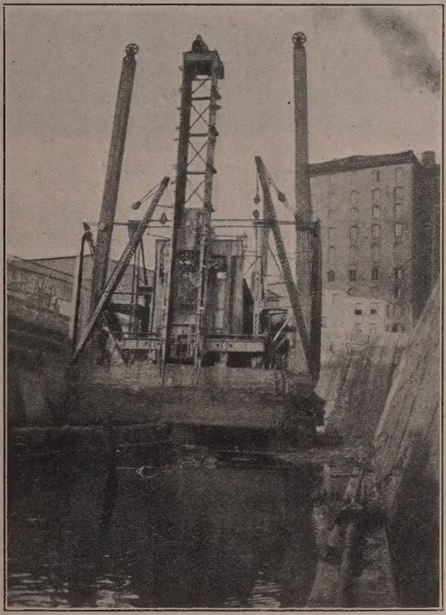

12"x8"x1½" Creosoted Oak Bearing Pieces, 2' c. to c.
Column of Shed
5'6"
5'0"
7'3"
8"
3'6"
2" in Concrete
10"
3'8"
4'9"
Fender 24"x5"
2-Ply 3½x2" Creosoted Sheeting
12"
12"
2" Drain Pipes 15' c. to c.
Gussets, 9" thick, 6' c. to c., between Bents
Wood Plugs to receive 14"x⅝" Spikes
2-Ply 2" Creosoted Sheeting

Fender and Other Pier Details

mained to be added when the work was shut down last winter. The temporary finishing off of the deck beams and slabs at this point has been so arranged that there will be no line of weakness when the pier is completed. This is being done by hooking all projecting reinforcing rods and by the addition of some special rods to take care of the continuous beam action. Beam seats have been built on the east side of the pile of the bent in question to carry the shore ends of the beams of the portion still to be built.

PERSONNEL

The entire work is being done by the Nova Scotia Construction Company, of Sydney, N. S., under the management of Hamilton Lindsay, vice-president of the company. John Kennedy, consulting engineer, of Montreal, is the designer and chief engineer, and is represented on the work by A. F. Dyer, resident engineer. The major part of the foregoing article was prepared from a paper presented some time ago by Mr. Dyer to the Nova Scotia Society of Engineers.



Special Pile Driver in Drydock

UNPROTECTED PILE TOPS of white pine more than 80 years old were found perfectly sound and good when removed recently from the foundation of Piers 9 and 10, North River, New York. The submerged lower parts of these piles were in perfect condition except for slight evidences of the teredo, which had evidently disappeared very soon after the piles were driven. The tops of the piles, about 6 ft. long above high-water level, were as sound and good as the submerged portions. These piles were located near the center of the pier, where the deck shielded them from sun and rain, and were in an open well-ventilated space not subject to rapid drying out by direct sunshine. The pier from which these piles were taken is one of the oldest that has been removed in New York, and in it, as in others, it is found that timber is durable under favorable conditions, although similar piles in the exterior rows of the foundation, which are subject to more rapid drying out by direct sunshine, are liable to decay in the sections above high-water level.

Broadened Investigations by the Bureau of Standards

Studies to Be Made of Concrete Road Slabs and Stucco Panels under Various Conditions

PLANS are now in process of formation by the Bureau of Standards for broadening two important lines of investigation. The studies made last year in concrete roads, which indicated that expansion and contraction were due more to moisture content than to temperature, were carried on on slabs far removed from the headquarters of the bureau. Consequently measurements could not be made as frequently as desired nor at those special times when the readings might have had the greatest significance. Moreover, the slabs being laid under working conditions did not always represent the variables which it was desired to investigate.

It so happened that the bureau for some time had contemplated the laying of new roadway surfaces in its grounds at Washington, and this plan suggested to Rudolph J. Wig, assistant engineer physicist in charge of cement investigations, that concrete slabs be laid under quite a variety of conditions. By having the specimens under test right at the bureau's door it will be possible to take observations several times each day through all seasons of the year, and also to give certain slabs special treatment in order to observe its effect upon expansion and contraction and the life of the slab.

The condition of the base will be varied, since expansion and contraction are influenced by the smoothness or roughness of the material under the slab. Some slabs can be kept constantly wet, while on all it will be possible to take not only strain gage readings, but also measurements of displacement movements and differences in elevation. Contracts for the laying of the pavements have not yet been let, but the plans are being rapidly completed.

STUCCO INVESTIGATIONS

The second line of investigation deals with stucco. It is proposed, under the plans so far as now matured, to divide the investigation into three parts: (1) A study of experiences with stucco in all parts of the country; (2) search of the literature of the art; (3) tests at the bureau on panels of good practicable size.

On the panels to be constructed at Washington all of the important variables will be studied. The backing will be of metal lath, wood lath, tile, etc.; the materials will be mixed in various proportions; the efficacy of waterproofing will be considered, and, in general, all of those factors included which experience or theory indicates are worthy of study.

The program is now in a formative stage and is being criticized by representatives of various interests, which are indicated by the list of members of the committee given below. In addition, practical plasterers are to be called into consultation so that there will be assurance that all classes which can aid in shedding light upon the matter will be represented.

The study will be under the general direction of Rudolph J. Wig, engineer-physicist of the Bureau of Standards. Working with him will be the following committee: W. E. Emley and J. C. Pearson, of the Bureau of Standards, the former having made investigations of lime and the latter of stucco; C. M. Chapman, engineer of tests, Westinghouse Church Kerr & Company; H. S. Spackman, of Philadelphia, who has long been interested in the production of Alca limes; W. E. Carson, president of the Lime Manufacturers Association; H. J. Brown, of the Gypsum Industries Association; H. B. McMaster, of the Associated Metal Lath Manufacturers, and L. R. Ferguson, of the Association of American Portland Cement Manufacturers.

Effect of Storms on Breakwaters

Suggestions Based on Damage Done to Harbor Works in the Great Lakes in the Storm of November, 1913

DAMAGE done to breakwaters in Lake Huron and Lake Erie by the severe storm of November, 1913, is discussed by Lieut.-Col. Mason M. Patrick, Corps of Engineers, U. S. A., and R. B. Perry, junior engineer, in the May-June "Professional Memoirs."

At Harbor Beach, Mich., there is a breakwater 4695 ft. long. On the cribwork is laid a sort of gridiron of concrete blocks, consisting of three independent rows of 10 x 4½ x 4 ft. blocks with intervening spaces of 11½ and 7½ ft. respectively, and transverse blocks at intervals. The outer row of longitudinal blocks is laid as headers, the tops are paneled or indented, the intervening compartments between blocks filled with rubble and on top of the whole are laid large blocks of mass concrete, shaped with a level inner deck 12 ft. wide, a center parapet 8 ft. wide and 5 ft. high and a slope to the outer face.

Where damage was done these blocks cracked just inside the parapet and moved outward, and in a number of instances they broke just outside the parapet and at other points on the outer slope, the broken pieces settling more or less. In many cases the outer footing blocks disappeared entirely, allowing the rubble to settle away, and the inference is drawn by Lieutenant-Colonel Patrick that the footing block is an element of weakness.

To repair the breakwater without tearing out and replacing the damaged blocks it is proposed to riprap heavily along the outer face, using small stones for the core and the largest obtainable for the face.

At Cleveland three types of rubble-mound breakwaters have been used—the earliest having a large core of sand, the next having a much smaller percentage of sand, surrounded by shale between the sand and riprap, and the latest, with a narrowed base, eliminating the sand and using a stone core. This last type suffered little or none in the storm. The earlier types were extensively damaged, however, the greatest damage occurring where there was the greatest amount of sand used in the core. The conclusion is reached, therefore, that the violence of the waves caused leakage of the sand core and allowed the surface stone to settle.

THE STANDARD TESTING LABORATORY, Bureau of Standards, Board of Estimate and Apportionment, New York City, should have been credited in the article "Improved Asphalt Penetrometer," in the Engineering Record of May 23, as the office in which the device was developed by Hermann W. Mahr.

Condition of Steel Pipe After Seventeen Years' Service

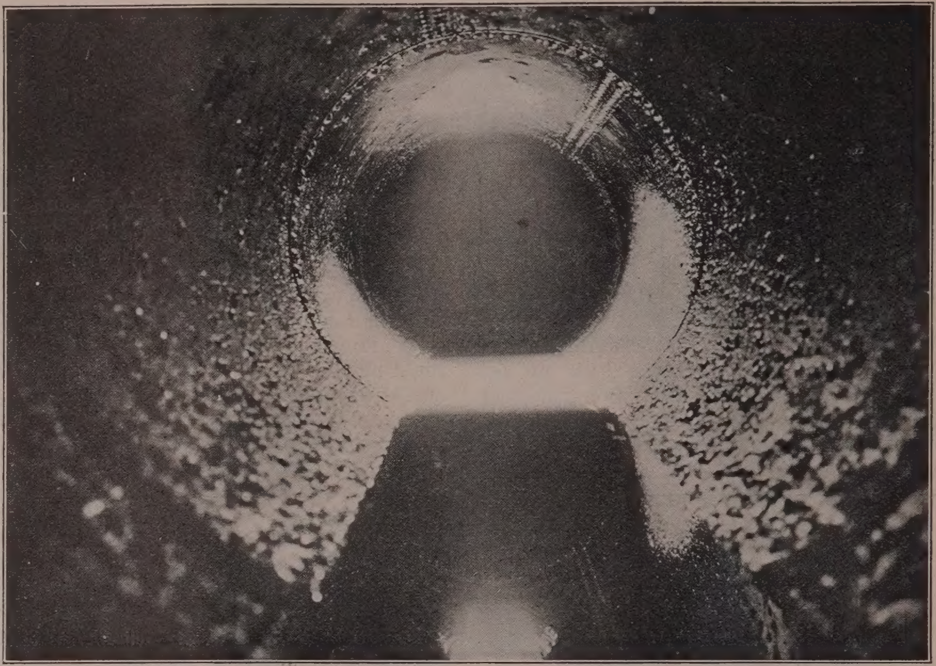
Results of Examination of 48-Inch Main at New Bedford, Reported on by R. C. P. Coggeshall

AN external and internal inspection of the 48-in. steel force main which has been in service seventeen years at New Bedford, Mass., was made on May 18, 1913. The results of the examination are published in the 1913 annual report of R. C. P. Coggeshall, superintendent of the water board. The pipe was laid in 1896 and was first inspected May 21, 1908. At the inspection on May 18, 1913, there were present Thaddeus Merriman, of the New York Board of Water Supply; Leonard Metcalf, consulting engineer, of Boston; George H. Nye, city engineer, of New Bedford, and Mr. Coggeshall.

The party first entered the pipe through the High Hill reservoir gate house, and proceeded northerly, first through the short stretch of 48-in. cast-iron pipe, then entering upon the steel pipe and proceeding a distance of about 1200 ft. The number of tubercles upon the interior surface was estimated in 1908 to range from three to seventy per square foot, with very few sheets showing the larger number. There has since been a probable increase of from 10 to 20 per cent. The pittings beneath the tubercles have not grown materially deeper, and the tubercles have not, so far as could be judged, increased very greatly either in size or in numbers. The average depth of the pittings now ranges from 0.075 to 0.090 in. The deepest one found was 0.110 in., which is no deeper than one found five years ago. The thickness of the steel plate is 5/16 in. or 0.312 in. It will thus be noted that this extreme pitting scarcely exceeds one-third of the thickness of the steel, and this pipe has now been in constant service for seventeen years.

In the cast-iron pipe the tubercles themselves have grown considerably in size. The extent of this growth is best indicated by the four outer rings, which can be clearly seen on photographs, showing the under or contact side of tubercle. Photographs showing the top and side view of sample tubercles from the cast-iron pipe are also submitted.

Samples of tubercles from the cast-iron pipe which enters the High Hill reservoir gate house were collected and analyses of the soft central or middle portion thereof and of the tubercles as a whole were made. Results of these analyses are given in Table 1.



Condition of Interior of New Bedford Steel Pipe Line in May, 1908

TABLE 1—ANALYSIS OF TUBERCLES

Material	Per cent Sample A	 Sample B
Silica and insoluble matter	3.24	1.78
Ferric oxide, Fe_2O_3	69.12	68.62
Alumina and lime, Al_2O_3 and CaO	traces	traces
Sulphuric anhydride, SO_3	1.36	0.55
Water of hydration, H_2O	26.28	28.16
Carbon dioxide, CO_2	None	None

Sample A was from the soft central portion of the tubercles from the 48-in. cast-iron pipe. Sample B was a whole tubercle from the 48-in. cast-iron pipe.

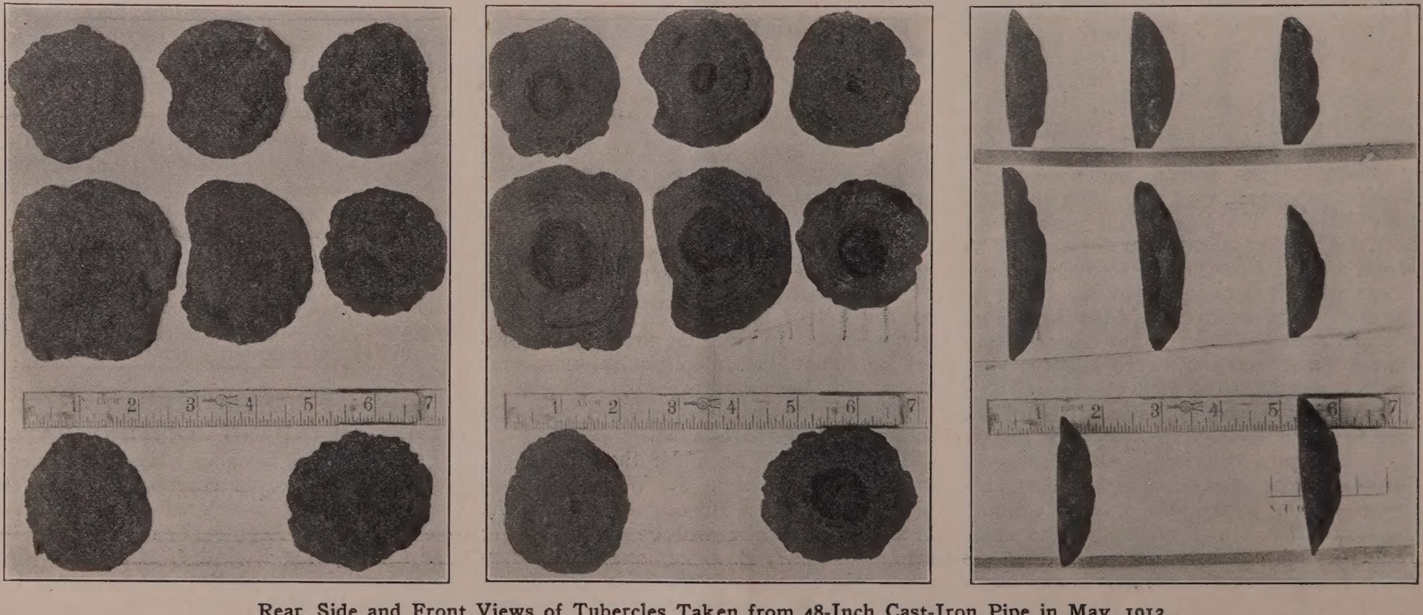
The interior of the steel pipe is now plentifully lined with blisters as well as tubercles. The blisters, however, far outnumber the tubercles. The number of blisters has somewhat increased within the past five years. In a way they help to protect the steel, for there is seldom any trace of rusting found upon the steel beneath them. Under the blisters the steel is generally sound and smooth and in most instances the mill scale, or coating of magnetic oxide of iron formed during the rolling of the plate, is intact. The water held by these blisters is of an alkaline nature. It is not as alkaline now as it was five years ago. Occasionally, under the blisters, rust is beginning to appear, but not yet sufficient to affect the surface of the steel.

TABLE 2—ANALYSES OF BLISTER WATER

Material	Parts per million Sample C	 Sample D
Total solids	637	1998
Loss on ignition	164	516
Mineral residue	473	1482
Alkalinity	518	1614
Lime, CaO	trace	trace
Chlorine, Cl	trace	30
Sulphuric anhydride, SO_3	31	55

These blisters are of all sizes up to 2 and 3 in. in diameter. A sample of water from between these blisters was taken, and analyzed with the result shown in Table 2.

Sample C was from the High Hill end of



Rear, Side and Front Views of Tubercles Taken from 48-Inch Cast-Iron Pipe in May, 1913

the 48-in. steel conduit, and sample D from the Beaver dam section above the conduit.

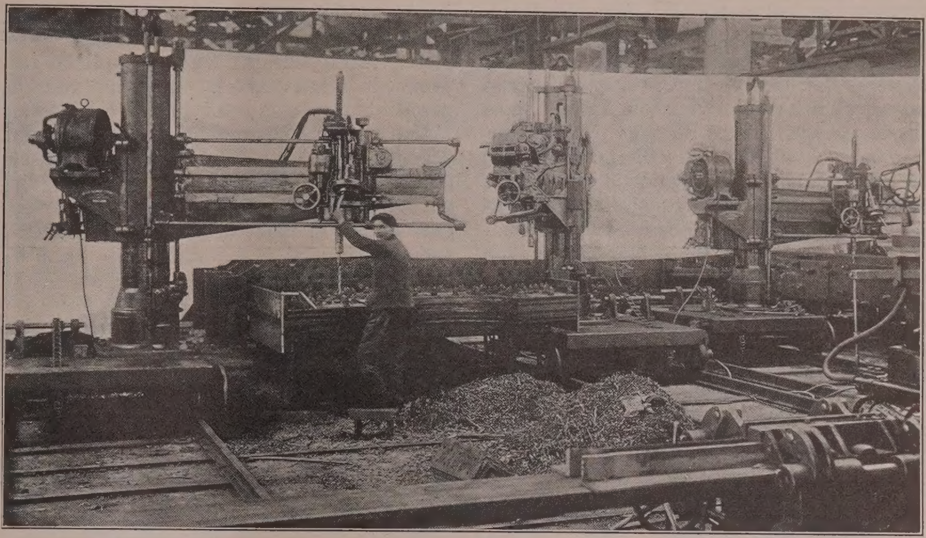
The ignition was attended by darkening, indicating presence of some organic matter. Alkalinity due to fixed alkalies, hydrates and carbonates of sodium and potassium were determined by titration with one-fiftieth normal acid.

Later in the day the pipe was entered at the Beaver Dam. This section was examined on May 22, 1908, and again on Oct. 22, 1909. The conditions were found to be generally similar to those at the time of the last examination, although it is quite certain that the number of blisters has been increasing while the tubercles have remained practically constant as to numbers. The deepest pitting found was 0.112 in., which shows no increase over the extreme depth found five years ago. A sample of water from behind the blisters was taken and the analysis of same is presented in Table 2. Here were found frequent small patches of spongilla, none of which were seen in the High Hill section. Later in the season these will be very much larger in size in all parts of the pipe.

ASPHALT COATING

The inside asphalt coating in the steel pipe has lost most of its original elasticity, but the facts that new blisters have formed and that old ones have increased in size seem to indicate that some elasticity still remains and that the coating is still of value as a protection to the steel. Walking through the pipe breaks this coating up, and there seems to be no question but that the less it is disturbed the better it is for the pipe. It seems probable that the carrying capacity of this pipe has not changed much from that of the two previous examinations, but this is due in part to the low velocity of flow through it. In the various places where the outside coating was examined it was found to be very smooth and in excellent condition.

Thus far there have been very little reliable data upon which to base the probable life of a steel pipe of this character, though this life is dependent on the quality of the water carried. When this pipe was laid seventeen years ago it was expected to last at least twenty-five years. Previous to this installation the comparative merits of steel and cast-iron pipe were the subject of much discussion by the water board, with their constructing engineers, George S. Rice and George E. Evans, who convinced the board that the cost of the steel pipe would be about 28 per cent less than that of a cast-iron pipe of the same size and that the steel pipe would have an assured life of at least twenty-five years. Thus the city could well afford to replace the steel pipe every twenty-five years rather than pay the extra cost of installing the cast-iron. That this has proved to be a very wise decision is now confirmed by the fact that in the opinion of those who have just examined this pipe it is still in excellent condition. They find the interior conditions to be such that a long life is still in sight. It seems that the pitting of the steel upon the interior surface instead of advancing by penetrating the steel more deeply has to some extent at least been active in spreading itself out over somewhat larger areas and to lesser depths. So with this seventeen years' experience before us, Mr. Coggeshall's report states, it is now very easy to prophesy its reliability and usefulness for many years exceeding the twenty-five year limit.



Drilling Rivet Holes in Web before Assembling Pedestal

Main Pedestals for New Quebec Bridge

Four 400-Ton Built-Up, Riveted and Cast-Steel Members Supporting Cantilever and Anchor Arms on the Main Piers

THE entire reaction of the new Quebec Bridge is transmitted to the main or river piers through four steel pedestals, each proportioned for a maximum load of 55,000,000 lb. This load is distributed over an area of about 550 sq. ft. on the top of each pier, which allows a maximum pressure on the masonry of about 700 lb. per square inch. The pedestal has an area at the base of 26 ft. 8 in. x 20 ft. 10 in., and is 19 ft. high. To facilitate handling and erection, it is built in three stories, the lower section or base being of cast steel and the two upper sections being constructed of plates and shapes riveted together. The details are so elaborate that this member is here illustrated simply by diagrams showing the outlines and general arrangement.

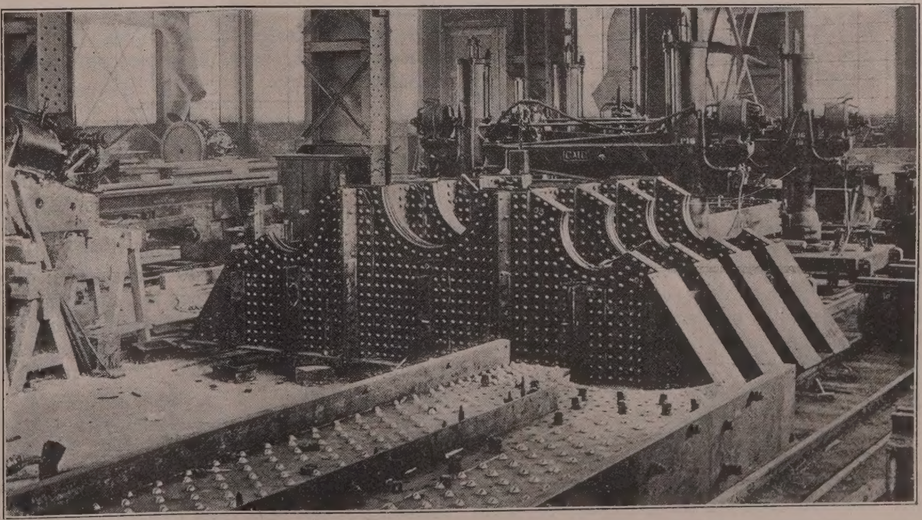
In addition to transmitting and distributing the very heavy vertical reactions from the bridge to the main pier, the pedestal also transfers the horizontal component of the stresses from the main diagonals and bottom chords of the cantilever arm to the corresponding members in the anchor arm. This is possible from the fact that these members, as well as the main vertical post, transfer their loads directly to the pedestal by means of individual pin-bearing connections.

CAST-STEEL BASE

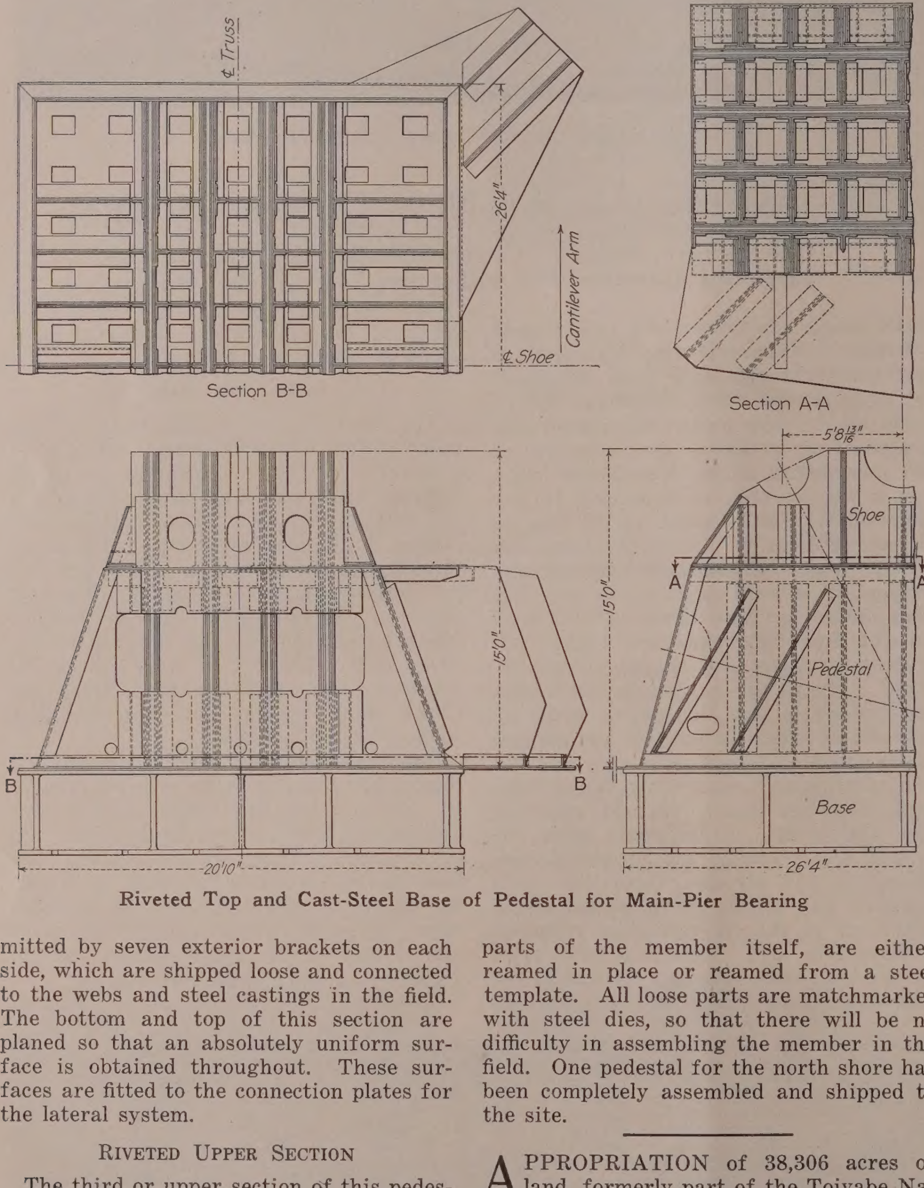
The lower portion of the pedestal is composed of four 6-ft. 8 in. x 20-ft. 10 in. steel castings 4 ft. high, reinforced by cross-webs 2½ in. thick, and having heavy top and bottom flanges. These castings are planed on all sides, great care being taken to obtain a uniform depth. When put into position they are bolted together with 2½-in. bolts through their exterior flanges. Manholes are left in the top flanges between each cross-web, in order that workmen may have facilities for driving the rivets connecting the bottom and middle sections of the pedestal.

Each casting weighs approximately 35 tons. When put in place it is secured to the masonry by twenty-eight 3-in. anchor bolts through the exterior flanges, 5 ft. into the masonry. There are also sixteen 3-in. steel dowels extending the same depth into the masonry in the interior of the castings. When the steel castings are fully in place and riveted to the upper section, the interior will be filled with concrete.

The second or middle section is composed



Pedestal Webs Assembled for Boring Pin Bearings of four vertical webs 9 ft. 6 in. high, securely tied together by interior diaphragms. In order to facilitate handling and erection, this section is shipped in two halves, each having two webs. These webs are bored with a half hole, 45 in. in diameter on each side, to take the bushings for the 30-in. pins through which stresses from the bottom chords are transmitted. Bushings and pins are in duplicate, each extending over two webs. This is necessary on account of the fact that the chord itself is erected in halves. The maximum thickness of pin bearing on these webs is 9¼ in., made up of plates riveted together with 1⅛-in. rivets. The vertical reactions coming upon these webs are further transmitted by seven exterior brackets on each side, which are shipped loose and connected to the webs and steel castings in the field. The bottom and top of this section are planed so that an absolutely uniform surface is obtained throughout. These surfaces are fitted to the connection plates for the lateral system.



Section B-B

Section A-A

Riveted Top and Cast-Steel Base of Pedestal for Main-Pier Bearing

RIVETED UPPER SECTION

The third or upper section of this pedestal is composed of four webs, each corresponding in their center-to-center dimensions to the webs of the lower section. This section is shipped in one piece with heavy shop-riveted diaphragms between the webs. On the outside of the outer webs heavy brackets are also connected, which distribute the stress through the similar brackets on the middle section and thus to the base and masonry. This portion of the pedestal has two 30-in. and one 45-in. half-pinholes, which carry the bushings for the main compression diagonals and main vertical post respectively. Duplicate bushings and pins are also used for these members. The bottom of this section is planed to a dead level parallel to the axes of the pinholes, after the member has been riveted up complete. The pedestal when completely assembled weighs about 400 tons and, as noted above, is shipped in seven pieces.

The upper and middle sections of the pedestal are covered with steel fascia plates, and manholes through all diaphragms and at other points make every part of the member accessible for erection and painting.

SHOP ASSEMBLING

Before leaving the shop the entire member is assembled and all holes for field connections of the sway bracing and laterals, as well as the holes connecting the several parts of the member itself, are either reamed in place or reamed from a steel template. All loose parts are matchmarked with steel dies, so that there will be no difficulty in assembling the member in the field. One pedestal for the north shore has been completely assembled and shipped to the site.

APPROPRIATION of 38,306 acres of land, formerly part of the Toiyabe National Forest in Nevada, for public use has recently been made by President Wilson upon the recommendation of Secretary of the Interior Lane. A similar restoration has been made of 32,740 acres from the Siskiyou National Forest in Oregon, of which 17,625 acres have already been disposed of under the public-land laws. The President has also signed a proclamation adding 91,630 acres to the Fillmore National Forest in Utah. This action was taken principally in order to secure a better administrative boundary for the forest and to protect the watershed in the vicinity of the town of Beaver. The withdrawn land is largely surveyed and unappropriated.

State Aid for Settlers on Irrigation Developments

Elwood Mead Explains Plan of Loans and Partial Payments as Practised in Australia

ABSENCE of adequate financial help for settlers during the first five years is the main cause for the stagnation in irrigation development in this country. Costly dams and permanent works mean much higher water charges than were paid by the earlier generation of irrigators, until the marvel is not that many fail but that any endure. With water rights costing from $40 to $60 per acre, and with the present Western interest rates, the chances are all against the success of the settler who has less than $5,000 or $6,000 capital. This is the opinion expressed by Elwood Mead, chairman of the State Rivers and Water Supply Commission of Victoria, Australia, in a paper delivered at the Irrigation Conference in Denver, Colo., on April 9. The question which now needs to be decided, according to Mr. Mead, is whether opportunities under national or private works are to be restricted to the men with this larger capital, or whether poorer men should be helped to improve their farms.

PROBLEMS OF SETTLEMENT NEGLECTED

Thus far in America we have almost entirely ignored the requirements of colonization and settlement. We have looked upon the building of irrigation works and the marketing of irrigation securities as the main problems of irrigation development. We have not given enough thought to the obstacles which confront the farmer in completing the work of reclamation, and the risks and hardships imposed on himself and his family when they undertake the development of raw land, and the payment of high charges now imposed. Another mistake has been to regard irrigation enterprises as something which could be paid for quickly. We have taken it for granted that if the works were built the farmer would come forward and foot the bills. The actual facts are entirely different. Irrigation works do not create irrigated agriculture. The money spent on dams and canals must be followed by an equal or greater expenditure for houses, farm buildings, fences, grading and ditching fields before the water can be used and irrigation works have either revenue or productive value.

Owing to settlers not being able to obtain financial aid many have not been able to complete the preparation of their land for irrigation in a reasonable time, and, as a result, have failed, when through timely assistance they would have succeeded. These failures have deterred others from attempting settlement; hence a large part of the irrigable land is unoccupied. Until this is changed the reclamation of irrigated land will continue to involve regrettable hardship and loss to many deserving settlers. Development will be slow and irrigation securities will have uncertain value. Irrigation works will not fulfil their greatest purpose, which is to create opportunities for poor men, and American farmers will continue to emigrate to the ready-made irrigated farms of Australia and Canada.

Adequate financial aid for settlers during the first five years is the great question. It is also the one about which there is likely to be the greatest difference of opinion. No one doubts its need or value if wisely and honestly managed, but many do not regard it as feasible simply because it has not been attempted.

STATE AID FEASIBLE

With respect to the latter, Mr. Mead has had during the past five years a most convincing and instructive experience. As chairman of the State Water Commission of Victoria he assisted in carrying out one of the most complete schemes of State aid to irrigated settlement ever attempted.

Seven years ago the situation under the irrigation schemes of Victoria was not unlike that under the Reclamation and Carey Acts projects to-day. Canals were built, water was available, but settlers were not there to use it, and hence the works were unprofitable. The State government determined to change this by creating conditions which would enable anyone who had industry and thrift to secure an irrigated farm even if he had little or no money, and which would warrant its inviting settlement from distant countries. It has succeeded in its purpose by requiring only small initial payments and giving adequate aid and direction. No charge is made for water rights, and the annual payments for water are only intended to cover 4 per cent interest on the cost of works and the expenses of operation and maintenance. The cash payment on land is only 3 per cent of its cost and thirty-one and one-half years is given in which to complete payments with interest at 4½ per cent. Houses are built for settlers on a cash payment of about one-fourth the cost; payments of the remainder may extend over twenty years with 5 per cent interest. The State, when desired, grades and seeds a portion, up to one-fourth, of each farm on the payment of one-fifth the estimated cost and allows the payments of the remainder to extend over ten years. It employs disinterested expert advisers to help the settler select his farm, buy his horses and cows and do what is needed to get established on his farm. The saving in money and time which this system effects can only be appreciated by those who have seen it in operation. Many settlers select their farm and arrange for the erection of their house before leaving Europe, are able to go directly from the ship to their new home, and have a living income from a dairy herd within a month from their arrival.

The State follows up this initial assistance by loaning the settler 60 per cent of the value of any improvements he makes. This enables men with small capital to complete without delay the grading, seeding and improvement of their farms. The settler does not need to halt when he exhausts his own capital. When he has one field graded he can borrow money on that to grade another.

This generous aid and the thoughtful consideration for his welfare is a great encouragement and incentive to the ambitious and earnest beginners. Nowhere do men work as hard or achieve as much in the first two years as on those Victorian settlements. But all who come are not industrious or capable. Such a scheme is especially attractive to the visionary and incompetent. Some of the settlers seem to regard the house, the farm and the graded fields as an endowment, and to believe that the State which has done so much to help them succeed will do the remainder. To help the inexperienced and guard against being imposed upon by the idler or indifferent, the State employs in each district a tactful, practical farmer who is the friend, counselor and adviser of the working settler and a stimulator to others. When his efforts and influence fail the fact is reported to the head office. The settler knows of this and also knows that such report will have a controlling influence in determining whether or not he is to obtain loans or be given sympathetic treatment when payments are delayed. The law is so framed that the commission administering it has discretion to defer payments where settlers are unfortunate, but it also has authority to eliminate promptly any settler who fails to show earnestness, industry and thrift.

This scheme of comprehensive aid has now been in operation for six years. The settlements that are three years old are practically established and self-supporting. It is the unanimous opinion of all those familiar with development that nowhere else have they seen such rapid progress in the cultivation of land or such large returns in the earlier years of settlement. One of the inspectors was formerly a successful farmer in the Imperial Valley, California. It is his belief that as much progress is made in these settlements in Victoria during eighteen months as was made on an average in the Imperial Valley in five years.

One cannot help being inspired by the hope, the gratitude and the tremendous industry that is everywhere manifest. The Government that inaugurated these measures is nearer a real democracy than a Government that leaves the settler to struggle unaided. While Australia and New Zealand have led in the movement to aid settlers, their example is now being followed in other developing countries. South Africa has adopted it and the newspapers report that British Columbia intends to adopt it. The Canadian Pacific Railway is loaning each settler on its irrigated tracts in aid of these initial improvements, and the Argentine is beginning to consider making such aid a feature of its colonization policy.

POLICY OF UNITED STATES

The adoption of a similar policy in the United States would relieve settlers of much anxiety and hardships without imposing any burden on the taxpayer. By using the public credit, long terms for repayment could be obtained at low rate of interest, and with settlers fitted for their work and given practical advice by the Government, repayment of loans would be assured and development would then continue under opportunities as favorable as those provided in other countries. Every condition that has secured the success of State aid in Australia exists here in equal or greater measure. The tenant farmers of the Middle West furnish a large body of the very best class of settlers. The country does not have to look for them on the other side of the world. The lands are here, the works have been built. All that is needed is the inauguration of some business-like scheme which will provide the funds, and exercise the necessary direction and oversight over the settlers.

The greatest need in this country is the complete use of the works already built. From Colorado to California are private and public works, with less than half the land under cultivation, and with inadequate revenues are struggling to maintain their financial credit. Suitable settlers would completely change the situation. Under some of these schemes the conditions for extending this aid are altogether satisfactory, whilst under others, settlement under present conditions should be prevented. Either the water supply is inadequate, the land is unfit, or the charges for land and water are too high. To extend public aid in the settlement of such enterprises means inevitable disaster to all concerned, and the first step in all such cases should be an investigation by some competent public authority, to weed out the sound from the unsound schemes. Starting with sound enterprises, there should, in each case, be an organization to meet and take charge of the settlers, and there must be some way by which large sums of money can be provided to give them the necessary aid.

SAVINGS-BANK FUNDS

In the State of Victoria this money is provided in a large measure by the State Savings Bank, which has deposits of $110,000,000, on which 3 and 3½ per cent interest is paid. This money is loaned directly to the farmers at 4½ and 5 per cent. A remote country, with small accumulations, thus gives the farmers money at about half the interest rates prevailing in the western part of the United States. It would seem that the Victorian policy might wisely be followed in the United States, and the funds deposited in the Postal Savings Bank of the nation loaned to farmers developing irrigated lands, rather than to the banks, as at present. The experience of all of the Australian States shows that not only is this a safe use for these funds, but it can be made a great agency for national development. Safety could be further insured by an arrangement under which the states would guarantee the returns of all funds loaned to settlers within their boundaries. In any event, the cost of improving land is as great as the expense of providing water for it, and if we are to have a humane and rounded out scheme of development, the settler's side must receive more consideration.

Beginning of Regular Commercial Service on Panama Canal

OPENING of traffic on the Panama Canal has already been announced in the Current News of this journal. More details are given in the "Canal Record." The first commercial service was instituted May 18. Within the next ten days twelve barges and the tug "Mariner" were diverted to the service and a schedule was established, under which about four of the barges are always being loaded at Balboa, four are in transit and four are discharging at Cristobal. It is aimed to make a complete round trip every twenty-four hours.

DECISION has recently been rendered by the Court of Appeals of New York State that engineering charges and the costs of maintenance and renewals of new bridges are legitimate parts of the amounts collectible by the railroads for changes necessitated by the construction of new channels for the Barge Canal. Three crossings of the New York Central & Hudson River Railroad were involved, and there are numerous parallel situations in the State.

Value of the Proper Location for Elevated-Storage Reservoirs

Economical Considerations Affecting Position with Relation to Main Pumping Station, Distribution System and Territory to Be Supplied

By DABNEY H. MAURY
Consulting Engineer, Chicago

SPEAKING broadly, a reservoir may be defined as a place where something is kept in store. As most commonly used, one understands the word "reservoir" to mean a receptacle for the storage of water. An impounding reservoir is one usually formed by building a dam across a stream. Suction reservoirs, storage basins, or clear-water basins are generally designed to store water which is pumped into them from wells or from streams, or which may flow into them from filters.

VALUE OF ELEVATED STORAGE

All of the reservoirs heretofore mentioned would naturally be located on the suction side of the main pumps which force water into the distribution system, and none of these reservoirs would have any value as a reserve against the temporary lack of capacity of these pumps. When, however, the reservoir is built as part of the distribution system, and at an elevation which corresponds to the static head on the discharge side of the main pumps, then the value of its storage is enormously enhanced because of the fact that the water stored in such a reservoir not only serves to help out the source of supply, whatever it may be—the low lift pumps, of whatever class, and the filters, if there are any—but it also stores the surplus water delivered by the main steam pumps when their pumpage exceeds the demands, and automatically gives out this surplus when these pumps are shut down or when the demand for water exceeds their capacity. Incidentally, also, such a reservoir smooths out the peaks of the load on the main pumps and enables them to operate much more economically.

The value of reservoirs of these different classes seems fairly well recognized by waterworks men, but the experience of the writer in at least five cities during the past year would seem to indicate that the value of the location of an elevated reservoir with regard to the main pumping station, to the distribution system, and to the territory to be supplied is not so fully understood and appreciated.

THREE SPECIFIC EXAMPLES

From these five cities three specific instances will be cited to illustrate the value of elevated storage and to give some idea of how this value may be ascertained.

In the first case the problem was to supply from 100,000 to 200,000 gal. per day to an industrial establishment about 7 miles south of the pumping station and about 5 miles beyond the city limits. At the same time it was necessary to provide for the continuance of the supply to one large industrial establishment and two large railroad shops, as well as to take care of the present and future requirements of domestic consumers along the line of the mains outside of the city limits, involving a total demand, during maximum hours, at a rate of more than 1,000,000 gal. per day.

The existing pressures enjoyed by all of these consumers were at times inadequate, this being due principally to the fact that the railroads and the industrial establishment took large quantities of water at certain hours of the day. To increase these pressures by carrying a higher pressure at the pumping station would have been quite expensive, because it would have involved pumping all of the water supplied to the entire city against the increased pressure. To cut down the friction losses by laying additional and larger mains would also have involved prohibitive expense, because of the very great length of the mains required. It then became necessary to determine the relative economies of a booster pumping station and of elevated storage. In this comparison, first cost, operating expense, and results obtainable in betterment of the service generally were all considered, and it was found that elevated storage offered, under all the circumstances, a far better solution of the problem.

This storage, properly placed, would not only provide adequate pressures for all of the service south of it, but would actually tend to improve the operating conditions at the pumping station and the pressures throughout the entire system by absorbing the worst of the fluctuations due to heavy draft by the large consumers.

NECESSARY DATA

The selection of the best location for this elevated tank required a good deal of study and involved the securing of data as to the elevations at all points where much water would be taken, and the determination of the minimum, average, and maximum demands, and the gage pressures corresponding to such demands, at each such point. The capacity of the tank had to be sufficient to take care of the hourly fluctuations in draft along the line of the main extension; and its elevation, and its location on this extension, had to be such that it would be automatically replenished every day during the hours of light demand for water. The computations were too long and too intricate for reproduction here; but they showed that the best location for the tank was at a point about 3 miles south of the city limits, or 5 miles from the pumping station.

In the second case the main pumping station was located about 2 miles north of the center of the congested-value district in the city. The elevated-storage reservoir, which had formerly been located close to the pumping station, had been destroyed, and it was necessary to provide a new elevated tank.

FIRE-SERVICE DEMANDS

For the purpose of computing the friction losses it was assumed that a fire broke out during sprinkling hours on a hot day in summer and that the plant would be required to furnish water at the rate of 4000 gal. per minute, distributed throughout the city for domestic consumption, in addition to a supply of 2000 gal. per minute for fire service, which latter amount would be drawn at or near the center of the congested-value district. It was found that if the tower and tank were located close to the pumps at the northern end of the city the pressure remaining in the mains in the congested-value district would be only 25 lb., whereas with the same elevated tank located near the southern end of the town the pressure remaining in the mains would be more than 53 lb. To have saved this difference of 28 lb. by laying additional mains from the pumping station to the congested-value district would have involved an expenditure of at least $30,000; so that it may be fairly stated that the advantage obtained in this case by locating the elevated storage near the center of the congested-value district instead of at the pumping station was worth not less than $30,000.

AVOIDING FRICTION LOSSES

The third case which will be cited was in some respects similar to the one last mentioned. A site for an elevated reservoir of a capacity of 7,500,000 gal. had been selected on an eminence opposite the main pumping station. The congested-value district in this city was comparatively small, and its center was more than 3 miles south of the pumping station. A topographical map had been made of the proposed reservoir site and test pits had been sunk through the top soil to bedrock, when the writer was called in to pass upon the suitability of the topography and soil conditions for a reservoir of the capacity contemplated. It was at once apparent that the location of the reservoir with regard to the pumping station, to the distribution system of mains, and to the territory to be supplied was far from being a desirable one. An examination was made of high ground opposite the congested-value district, with the result that a much more suitable site was discovered, which was later purchased by the city.

For the purpose of comparing the friction losses incident to the reservoir site originally chosen with those incident to the site recommended by the writer it was assumed that the rate of domestic consumption during sprinkling hours on a hot day would be 3500 gal. per minute, which quantity of water would be distributed throughout the city, and that in addition to this 4000 gal. per minute would be required to meet the demands of a fire near the center of the congested-value district.

The computations showed that had the reservoir been located opposite the pumping station the total friction losses would have been 96 ft., or about 41½ lb., whereas with the reservoir located near the center of the congested-value district the friction loss under otherwise similar conditions would be only 3 lb. The computations further showed that to reduce the friction loss to 3 lb. under the assumed conditions of demand, by putting in additional mains, would have cost more than $200,000. The expenditure of so large a sum of money would, of course, have been out of proportion to the benefits obtained, and the best economy would have dictated spending less money and putting up with somewhat greater friction losses. On the other hand, it would not have been economical to make the additional main smaller than 20 in. in diameter, had it been necessary to reduce the frictions by this method. The cost of even a 20 in. main would have been something more than $80,000. This sum is, therefore, considered to represent the lowest possible estimate of the advantage possessed by the site finally adopted for the reservoir over the one which had originally been chosen.

Salmon River Hydroelectric Development

A High-Head Plant for Which a 205-Foot Differential Surge Tank Was Necessary to Regulate a Column of Water 9625 Feet Long

A DEVELOPMENT of 30,000 hp, operating under a head of 245 ft., was recently put in operation by the Salmon River Power Company. The Salmon River flows from the foothills of the Adirondacks in a westerly direction through the northern part of New York State and discharges into Lake Ontario. The length of the stream is 44 miles and it drains a watershed 190 sq. miles in area with an annual precipitation of about 60 in. This river falls 650 ft. in the 17 miles between Stillwater and the lake and more than 400 ft. in a distance of less than 8 miles. At Salmon Falls, which in beauty equals that of Niagara Falls, the drop is 110 ft.

While the flow of the stream is somewhat irregular, the valley above the Salmon Falls is of a form suitable for storage purposes. Moreover, the location of the site is such as to enable the power company to dispose of the entire output of the plant to the Niagara, Lockport & Ontario Power Company, which has leased the property in perpetuity and acquired all its capital stock. The latter company draws its supply at present from the plant of the Ontario Power Company at Niagara Falls and from its own steam plants at Lyons and Auburn. It can utilize the full output of the new plant to advantage in combination with the other three.

Next to the Niagara River the Salmon River is the best source of water power in the State of New York. Its commercial possibilities for this purpose and as a source of water supply for Syracuse and for waterways through the central part of the State have been under consideration for a long time.

The concrete dam and spillway are situated near Stillwater, forming an artificial lake about 8 miles in length and 5½ square miles in area. The Salmon River is of the kind found all through the lake district of central New York. The riverbed is at the bottom of a narrow valley, with rather steep hills rising on both sides. At places the valley widens considerably, as, for example, just above Salmon Falls; at others it narrows into a gorge with steep banks, as at Stillwater. By the location of a dam at the latter point with a crest at El. 935 a large area was submerged with little loss of property, as the valley is sparsely settled. The height of the dam crest is limited to about 935 ft., unless more extensive dikes are built to prevent diversion of the water into the watershed of the streams draining into Oneida Lake, several of which take their rise on the south side of a narrow ridge which parallels the Salmon River closely on the south.

Artificial Lake and Dam

The artificial lake has a capacity of 2,600,000,000 cu. ft. with the dam crest at 935 ft., and, at the average rate of flow of the stream, about twenty days are required to fill it. With the crest at this height the average net head available at the power house, 2 miles away, is 245 ft. The total static head is 282 ft.

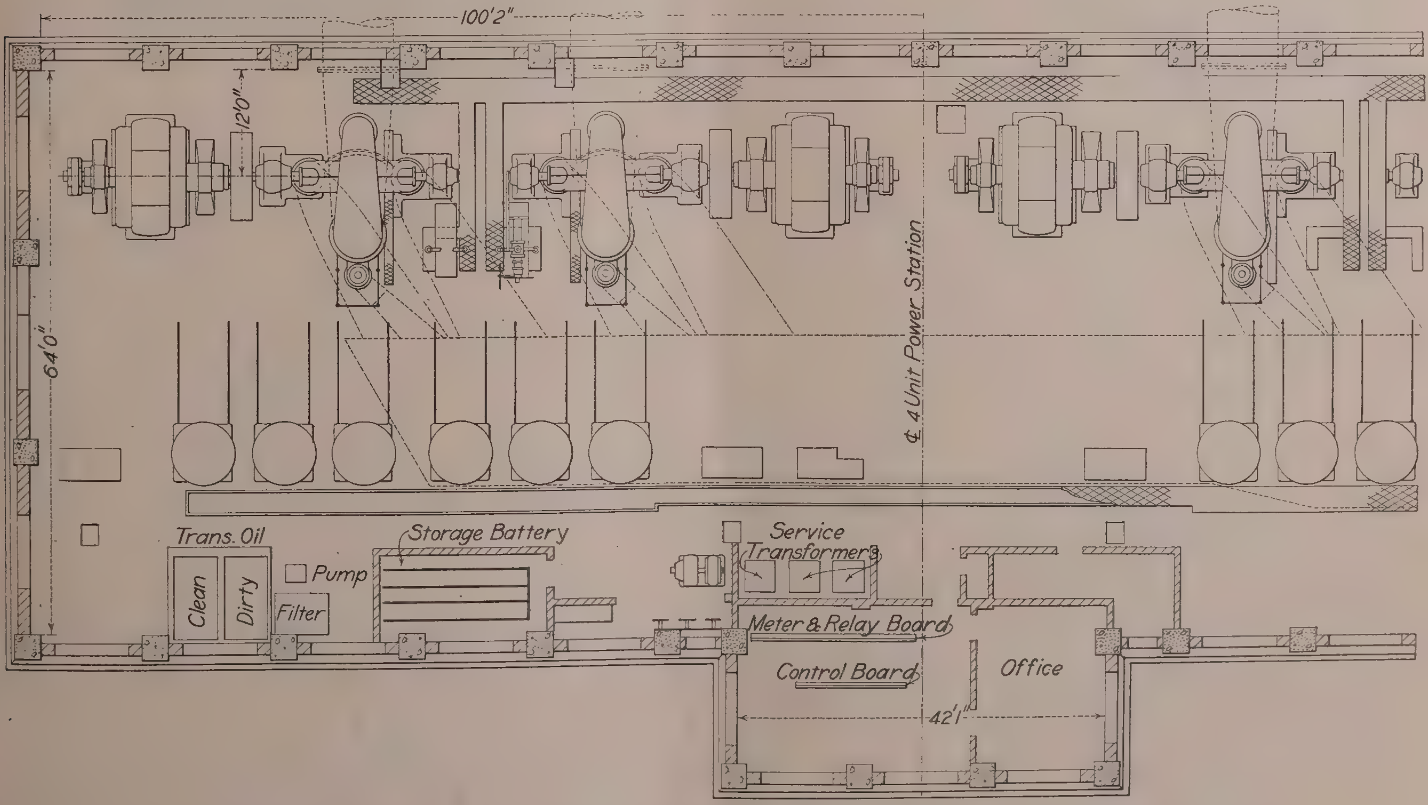
The present temporary crest of dam is at El. 924, but during the present year it will be raised to El. 935. On the downstream face of the dam is a 25-hp Pelton wheel for the gate drive, connected by shafting and bevel gearing to a longitudinal shaft in the gatehouse. By means of clutches the gate-raising mechanism is connected to this shaft.

The conduit connecting the dam and the power house consists of five sections—a 600-ft. reinforced-concrete-lined tunnel drilled through rock, a 7825-ft. wood-stave pipe, a 1200-ft. steel pipe, a steel distributor and four short penstocks. The topography of the country between the dam and the power house, which is situated at Bennett Bridge, is such that an open canal could have been used. The pipe line, however, was found to be cheaper.

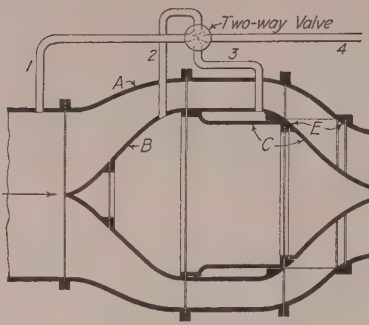
Tunnel

The tunnel was necessary to pierce the southerly ridge previously referred to. It is lined with concrete not less than 1 ft. thick, with circumferential reinforcing rods closely spaced, and it has an inside diameter of 12 ft. The wood-stave pipe continues at the same diameter for 3450 ft., the diameter being reduced to 11 ft. for 4375 ft. more. The staves are of kiln-dried Douglas fir cut not less than 3⅝ in. thick for the 12-ft. pipe and 4 in. for the other. They are joined end to end by means of galvanized-iron keys and are held circumferentially with bands of ⅞-in. and 1-in. steel rods. Each band is in three sections, all united by cast-iron clamps. In soft ground the pipe was supported on timber cradles, but otherwise it was laid directly on the surface. It was coated on the outside with Avenarius Carbolineum and afterward backfilled to about one-half its height. Relief valves were inserted at intervals to prevent undue pressure when emptying the pipe and to serve at air outlets when filling, and drains were placed at all low points. Wood pipe was selected for that part of the conduit in which the pressure was not too great because, in the cold climate of the region, it is cheaper than steel pipe when the latter is properly protected from freezing. Fir was used because it is an excellent wood for pipe not subjected to alternate wetting and drying in that it remains tight, does not rot and is reasonable in price.

The steel-pipe section is 1200 ft. in length and 11½ ft. in diameter. It is connected



Plan of the Generator Room of the Salmon River Hydroelectric Station, Indicating the Arrangement of the Units



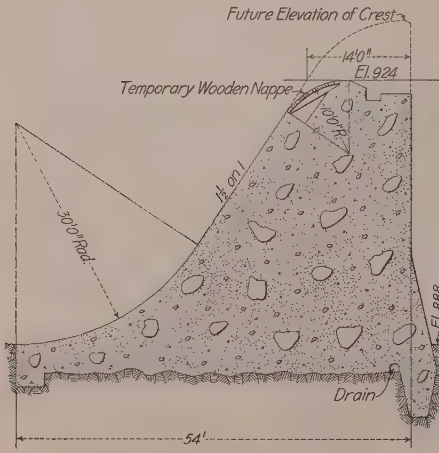
Cross-Section of Johnson Valve

to the wood pipe through an expansion joint packed with oakum and lead wool. Special attention was given to the material in this pipe, which was specified as open-hearth steel containing not over 0.05 per cent sulphur and between 0.3 and 0.6 per cent manganese. The phosphorus was limited to 0.06 per cent if the steel was made by the acid process and 0.04 per cent if by the basic process. The thickness of the pipe is ⅝ in. throughout. The steel pipe was mounted on concrete saddles 20 in. thick and spaced about 14 ft. apart. It was laid in a shallow well-drained trench, and a 6-in. sewer tile was molded in the bottom of each saddle to facilitate drainage. The pipe was housed over with a substantial structure of framing and boarding continued down to the ground level. The roof, of 1-in. boards, was covered with a layer of roofing paper. Trap doors were placed in the roof over all manholes.

Distributor and Surge Tank

On the crest of the ridge just behind are not only the most conspicuous but also the most original elements of the hydraulic equipment. First there is the distributor, a 12-ft. steel pipe 210 ft. in length and joined at one end to the pipe line in a huge concrete anchor block. The other end is closed by a bulkhead. The elevation of the bottom of the distributor is 775 ft., or 160 ft. below the crest of the dam.

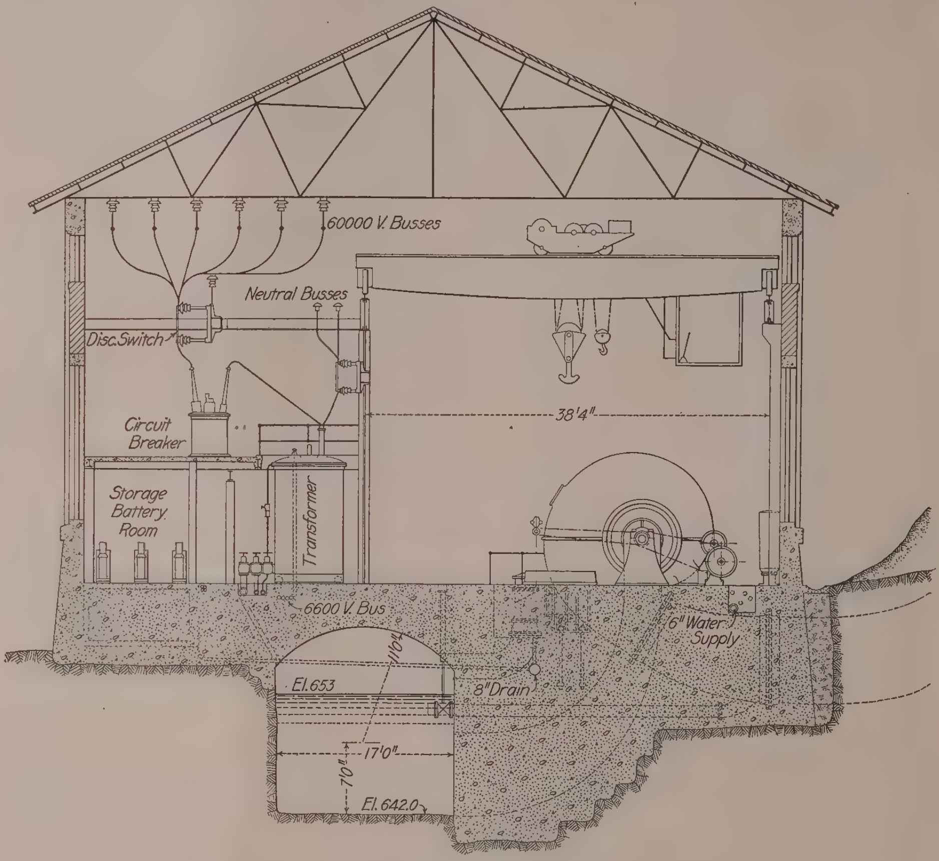
From the center of the distributor a 12-ft. riser branches off to a surge tank. This enormous T-connection requires reinforcing from side to side, and this is provided by a 9-in. bolt, 25 ft. long, with bearing washers 4 ft. in diameter. The surge-tank riser joins the distributor with easy curves, but a novel and cheaper connection is made to the penstock intakes, 8 ft. in diameter. This is a simple flanged and riveted joint, which would, without some modification, produce eddies and loss of head. To prevent such, wooden fillers suitably rounded off are secured around the mouths of the intakes inside the distributor.



Cross-Sectional Elevation of Dam

The distributor is a steel pipe, ⅝ in. thick inclosed in concrete.

The surge tank, built by the Kennicott Company of Chicago Heights, Ill., is the largest of its type yet constructed. It consists of a cylindrical shell, 50 ft. in diameter and 80 ft. high, surmounting a hemispherical bottom which adds 25 ft. to the height. Its capacity is 1,400,000 gal. The tank is supported on ten columns with heavy concrete footings. It is housed in with a framed wooden structure providing a surrounding air space which can be heated when necessary from a small house below. The top of the roof of this structure is 205 ft. above the ground, and the top of the tank is high enough above the crest of the dam so that if the flow of the water in the pipe line were suddenly interrupted its energy would be absorbed by the rise in level in the tank without overflow.

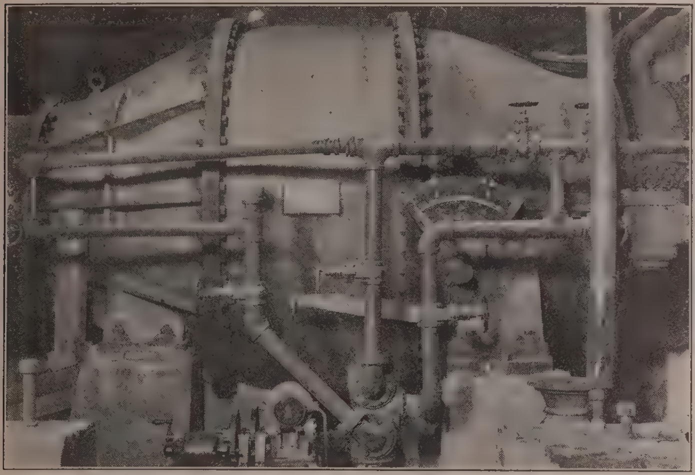


Cross-Section of Power House, with Elevation of Turbine

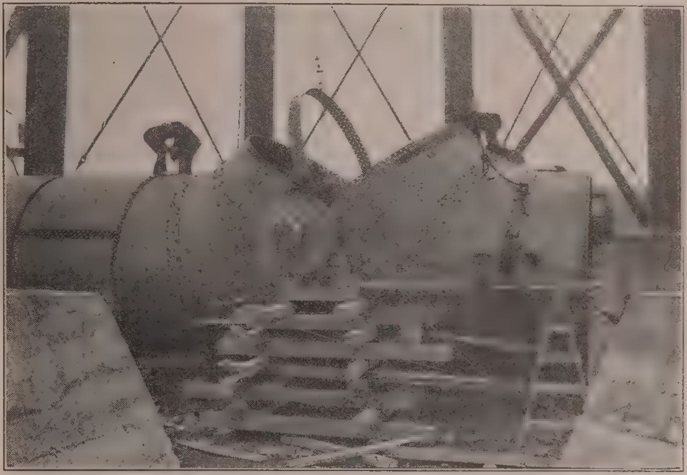
With a 12-ft. riser opening into the bottom of the tank there would not be friction enough to absorb the energy of a surge, which would tend to set up oscillations. To provide for the damping of such oscillations, a smaller pipe is mounted inside the tank, connected directly to the riser below and terminating in a funnel near the top. The rest of the mouth of the riser at the bottom of the tank is covered by a ring in which small ports are provided. A surge, therefore, produces a rise in the small pipe and some flow through the ports. The head in the small pipe then forces the surplus water through the ports and equalizes the pressure gradually. This process is technically termed "differential action" and is an invention of R. D. Johnson, hydraulic engineer, of the Ontario Power Company.

The four 8-ft. penstocks are connected to the intakes through valves of a type which represent a comparatively new development in hydraulic practice. They operate under a head of nearly 154 ft. The type of valve used is also the invention of Mr. Johnson, manufactured by the Wellman-Seaver-Morgan Company. The valve is shown herewith both in perspective and in diagrammatic section. It consists of a casing *A* supporting an internal stationary shell *B* pointed against the direction of water flow. A hollow plunger *C*, movable in the shell, carries a bronze ring *E*, which seats on a second ring *E*. The motion of the plunger is controlled by a two-way valve through piping as shown in the figure. The piping has four parts. No. 1 is tapped into the penstock, No. 2 into the space behind the plunger, No. 3 into a space between the plunger and the shell, while No. 4 discharges to the air. The operation of closing the valve consists in opening pipe 1 into pipe 2 and pipe 3 into pipe 4, putting pressure behind the plunger and gradually seating it. To open the valve pipe 1 is opened into pipe 3 and pipe 2 into pipe 4. The plunger can be stopped in any position, and an indicator, mechanically connected with it, shows its position. The two-way valve is motor-driven with electrical control on the main switchboard. The switchboard operator needs to know that the valve is being operated properly, although he is not concerned with its exact position. To give him a rough indication, a pilot-lamp circuit is closed at the quarter position of the indicator, once for quarter, twice for half, and three times for three-quarters open. In the closed position the lamp shines brightly, but in the open position it is dimmed by means of resistance.

Below the valve houses are the four 8-ft. penstocks, anchored above and below in heavy concrete blocks, and laid in trenches and back-filled. The steel plates vary in thickness from ½ in. on the upper hori-



Johnson Valve, with Its Operating Pipes



Connection Between Pipe Line and Surge Tank

zontal portion of the penstocks to 7/8 in. at the lower end where they enter the power house.

TURBINES

The four turbines are of the Francis horizontal, single-runner, double-discharge type of 10,000-hp rating each. The balanced wicket gates are operated by Lombard governors. These machines have guaranteed efficiencies of 82 per cent at full, 85 at three-quarters, 80 at half, and 70 at quarter loads. The specifications on governing permit not more than 15 per cent increase in speed above the normal value of 375 r.p.m. on the sudden removal of full load, 6 per cent for half, 3 per cent for quarter, and 1.5 per cent for tenth load. The turbines are provided with heavy flywheels to assist in governing and to facilitate the operation of the electrical equipment of the plant parallel with the Niagara, Lockport & Ontario Power Company's system. The turbines are provided with relief valves operated by the governors, so that the sudden checking of over-speed cannot result in an excessive rise of pressure.

The discharge of the turbines is conducted to the tailrace through short concrete draft tubes, entering at an obtuse angle to prevent eddies. In fact, on its entire journey from reservoir to tailrace the water is led with as few turns as possible and around easy curves. The tailrace is directly under the power house, which is built over the bed of a branch of the river that previously carried water at times of flood and was with little expense transformed into a tailrace. The exit of the tailrace from the building is closed by a curtain wall which prevents the ingress of cold air. The old riverbed, below the building, was cleared out for a distance of several hundred feet and the banks reinforced with dry-laid stone walls.

The power house is a simple structure consisting of reinforced-concrete pilasters connected with heavy concrete beams. The panels are filled with red brick outside and sand-lime brick inside. The roof, supported on steel trusses, is 3 in. thick, of gypsum composition reinforced with steel cables and rods. This is the Metropolitan Fireproofing Company's system, and was installed by the Keystone Fireproofing Company. The roof is covered with an asphalt coating overlaid with several layers of asbestos felt. One purpose in the use of this particular type of roof was to secure a fireproof base to which tile could be nailed in case it was later found desirable to add a tile roof.

The building is rectangular with a projecting feeder bay. The interior is open to the roof and, with the exception of a gallery about 12 ft. above the main floor on the feeder-bay side, forms one room. It is served by a 40-ton Shaw electric crane with main and auxiliary hoist all driven by 250-volt direct-current motors. The crane has a 38-ft. span and the runway covers the entire length of the building.

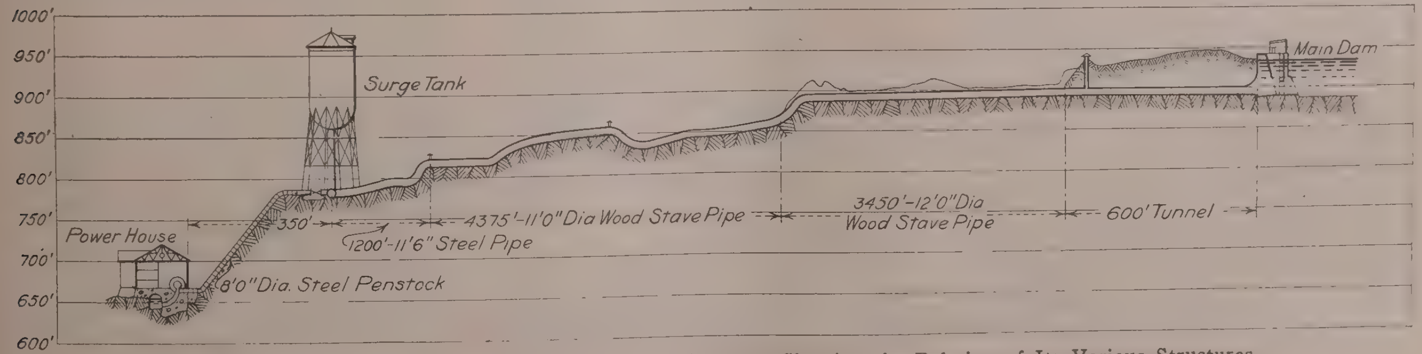
Each of the four electrical generating units consists of a 375-r.p.m., 6600-volt, twenty-five-cycle, three-phase generator with exciter mounted on an extension of the shaft; three 2200-kva., single-phase, twenty-five-cycle transformers with a normal ratio of 6600 to 34,650 volts, with high tension in star, giving 60,000 volts line tension; a 6600-volt, 1200-amp, triple-pole, single-throw, type "C" oil circuit-breaker, automatic for reverse power, and the necessary connecting cables and auxiliaries. Each unit is thus as nearly self-contained as possible, with all parts placed conveniently near together.

TRANSMISSION LINE

The line which connects the generating plant at Bennett Bridge with the substation of the Niagara, Lockport & Ontario Power Company at Solvay, near Syracuse, is approximately 42 miles long and comprises two circuits. The Salmon River line is to be tied in with the Niagara Falls plant of the Ontario Power Company, acting in general as a source of energy but occasionally as a synchronous condenser plant. Towers of greater strength than is usual for such lines were installed. The specifications called for the following test load strength: For the standard towers, a load of 4000 lb. applied in a horizontal direction at any one of the conductor or ground-wire supports, or a horizontal load of 12,000 lb. applied at the center of the tower at the middle cross-arm, or a vertical load of 2000 lb. applied at any insulator or ground-wire support, should not produce failure or permanent distortion of any member. For the strain towers of standard type the corresponding figures are 4000 lb., 3000 lb. and 2000 lb. The towers are heavy, not only on account of the great strength called for, but also because a very liberal allowance was provided for clearance to prevent the line wires from swinging together. The standard towers are designed for spacing ten to the mile.

The towers are of the square, rigid type. The height of the standard tower is 44 ft. to the point of support of the lowest insulator, and provision was made for extensions to be applied to the bases to raise some towers from 10 ft. to 20 ft. higher. While the insulators are placed in general one above the other, the middle one is offset. The vertical distance between cables is 8 ft., and the middle one on each side projects beyond the uppermost and lowest a distance of 6 ft.

The towers carry four cross-arms. The top one is for the ground wires and below it are two short arms and one long one, all carrying strings of insulators at both ends.



Elevation of the Salmon River Hydroelectric Development, Showing the Relation of Its Various Structures

About one-fourth of the towers are strain towers, and there are several special towers constructed to comply with the regulations of the steam railroads which have to be crossed. The parts of the tower are galvanized after manufacture and all bolts, nuts, washers, clamps and other small parts are sherardized.

All of the footings for the standard towers are of structural steel shapes, galvanized and provided with holes for the attachment of timber or other structures for adaptation to special conditions.

The engineering of the plant has been under the direction of V. G. Converse, chief engineer of the Salmon River Power Company. During the preliminary work and the designing period D. R. Cooper was assistant chief engineer. Most of the hydraulic features were designed by R. D. Johnson, hydraulic engineer, of the Ontario Power Company, and the electrical features by J. A. Johnson, electrical engineer, of the Ontario Power Company. Barclay Parsons & Klapp had charge of the engineering and construction of the dam and acted as consulting engineers for the entire work. General Francis V. Greene is the president of the Niagara, Lockport & Ontario Power Company. The plant was put into operation April 10, 1914. Two units are now in operation and the third and fourth are in process of installation.

Hypochlorite Treatment Now Firmly Established

Tabulated Typhoid-Fever Death-Rate Statistics for Eight American Cities Before and After Using the Chemical

THAT 600 cities in the United States are using hypochlorite of lime for water sterilization and that no city following a proper procedure has found it necessary to discontinue its use was the contention of C. A. Jennings in a paper read before the Illinois Water Supply Association on March 9. Where the bleach treatment has fallen into bad repute it has been due in his opinion to a poorly designed plant, improper application, anticipation of a removal beyond practical limits or to the fact that the method was not adapted to remedying the particular water trouble encountered. Beyond its sphere of usefulness, bleach treatment has practically no value.

Average Typhoid-Fever Death Rates per 100,000 Persons

City	Began using hypo	Before using Period	Before using Rate	After using Period	After using Rate
Baltimore	June, 1911	1900-10	35.2	1912-13	22.8
Cleveland	Sept., 1911	1900-10	35.5	1912-13	10.0
Des Moines	Dec., 1910	1905-10	22.7	1911-13	13.4
Erie	March, 1911	1900-10	38.7	1912-13	13.5
Evanston	Dec., 1911	1907-10	26.0	1912-13	14.5
Jersey City	Sept., 1908	1900-07	18.7	1909-13	9.3
Kansas City	Jan., 1911	1900-10	42.5	1911-13	20.0
Omaha	May, 1910	1900-09	22.5	1911-13	11.8

Statistics were presented to show that hypochlorite treatment is now firmly established, as it has accomplished what its conservative advocates originally claimed for it. The selective action on germs of waterborne disease has been proved by bacteriological analyses and typhoid statistics over a period of nearly six years.

Of the eight cities the maximum reduction, 72 per cent, was in Cleveland, and the minimum, 35 per cent, in Baltimore. The average was 51 per cent. The total population considered is 2,033,000 and with a reduction per 100,000 population for each year of 15.8 deaths with lives valued at $5000, $1,806,000 annually has been conserved.

Restraining Effect of Forests on Sudden Melting of Snow

Comparative Measurements of Melting and Runoff and Influence of Snow on Floods

By J. E. CHURCH, Jr.
Director, Mount Rose Observatory, Nevada

THE reading of Colonel Townsend's admirable address, presented in abstract in the Engineering Record of May 3, 1913, has prompted me to present the following data in modification of the belief of some that the forests tend to cause rather than to prevent floods. It is true that the action of rain on snow is the chief cause of floods, but it appears likewise to be true that forests retard rather than accelerate the cutting out of the snow. Measurements made by the writer during a week of warm weather and rain, March 11-21, 1910, show that the protection afforded the snow against rain and sun was directly proportionate to the density of the forest. The snow in the open suffered most of all.

These measurements were made at Tahoe City and Blackwood, California, two localities 5 miles apart. The rainfall during the period was 1.4 in. The maximum temperature was 54 deg. Fahr., the minimum 22, and the mean temperature 39.4 deg. The figures in the table give the water equivalent of the snow in inches.

This same phenomenon was observed by the Geological Survey in comparative measurements of melting and runoff in two districts—one densely forested and the other burnt-over—in the White Mountains, New Hampshire, April, 1912.

Since tree roots break up the soil deeply and assist the water to seek deeper levels, forested soils should be capable of storing more water without flooding than bare soils or those broken up merely by grass roots or the plow. It is admitted, however, that under the extraordinary conditions of excessive rainfall the snow, whether in the forest or the open, must ultimately go; but, according to the measurements presented in the table, the snow in the open will be the first to depart. Yet it is worthy of notice that in the very dense forest the loss of snow scarcely exceeded the rainfall, and in the mature fir forest with glades, which seems to be the ideal forest for the conservation of snow, the loss was only one-half greater than the rainfall, while in the open it was one and one-third times as great.

Even in rolling country where ravines abound it may be seriously doubted whether the snow is blown in sufficient quantities from the hills into the ravines to prevent or seriously retard floods. The Truckee meadows, surrounding Reno, Nevada, and the upper basin of the Truckee River are cases in point. Both are typical foothill regions, either wholly bare, except for sagebrush, or severely deforested.

Although the snow is evaporated by the wind and drifted somewhat to the lee slopes, the menace of floods is always present when the snow accumulates to its normal depth, and a Chinook wind with rain speedily brings matters to a crisis. However, if the snow cover is thin to the elevation of 7000 ft. the valley is secure from severe flooding, whatever the weather may be.

It is hoped that further data on this point will be presented by others. The data presented in the above discussion were obtained during investigations authorized by the U. S. Office of Experiment Stations and the Nevada Agricultural Experiment Station.

Water Equivalent of Snow, Inches

TAHOE CITY
Approximately 65 stations

Date	Open meadow	Forest of pine and fir	Fir forest
March 11	11.7	12.1	11.0
March 21	8.4	9.4	9.0
Loss	3.3	2.7	2.0

BLACKWOOD
Approximately 90 stations

Date	Open forest	Mature fir forest with glades	Dense fir forest
March 13-14	13.5	16.5	10.9
March 20	11.3	14.5	9.3
Loss	2.2	2.0	1.6

Appeal Water Rate Case to U. S. Supreme Court

The rate case involving the charge of the Birmingham Water Works Company, of Birmingham, Ala., one of the largest subsidiaries of the American Water Works & Electric Company, will be appealed to the U. S. Supreme Court by the city, which has lost in both the U. S. District Court and the U. S. Circuit Court of Appeals.

The principal question involved is whether a municipality can be held to a contract as can any other corporation or individual. Several years ago the waterworks company and the city entered into a contract establishing rates for a number of years. Then a later city government passed an ordinance reducing the rates, claiming that the city did not have the authority to make the contract and could not be bound to its terms. The company brought suit in the United States courts to enforce the contract and has been successful in both lower courts.

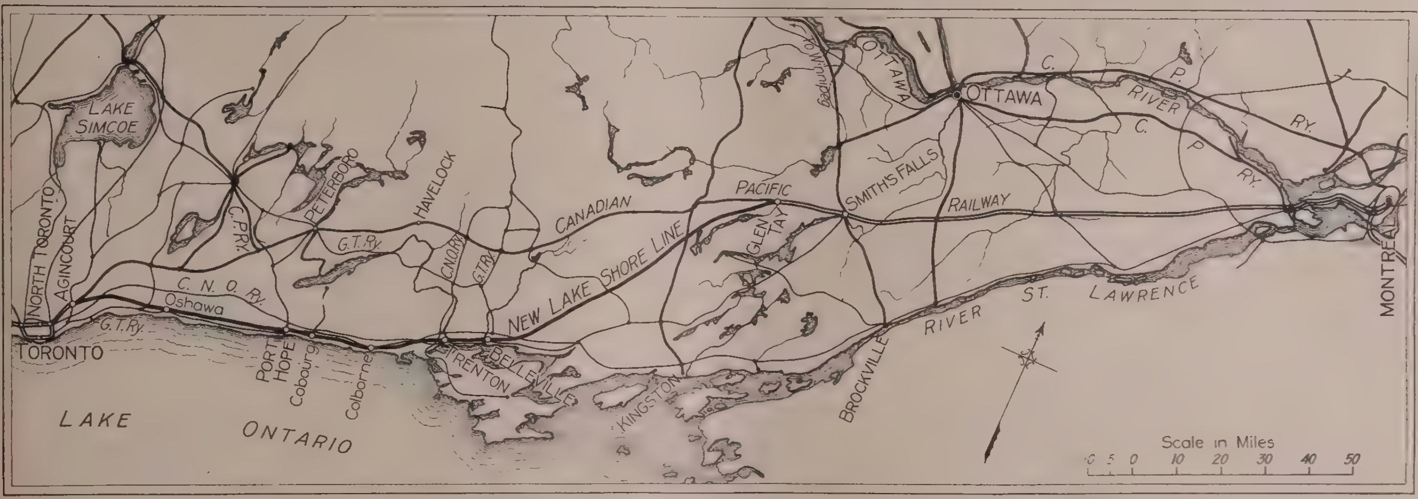
The city will now appeal to the U. S. Supreme Court and will ask that tribunal to construe the law relating to contracts by a municipality. It is claimed on behalf of the city that if a municipality has no power to abrogate a contract into which it has entered, such lack of power would be detrimental to good municipal government. It is expected that the court will outline just what contracts a city must live up to and what contracts it has power to abrogate. The decisions in the lower courts did not touch on this, simply denying the city the power to break a contract which had been entered into in good faith.

MOTOR-TRUCK traffic growth in New York State is shown in some surprising figures recently issued by the office of the Secretary of State. The total registration of commercial trucks for 1912 was 9806 and that for 1913 was 13,780, whereas for the three months February, March and April of 1914 13,807 trucks were registered. Of this total 8833 were credited to New York City, 3524 representing new cars. More than 120,000 motor vehicles of all kinds have been registered.

Campbellford, Lake Ontario & Western Railway

General Features of 180-Mile Low-Grade Alternative Line of Canadian Pacific on Route from Montreal to Toronto

A NEW line 182.6 miles long is the main feature of an improvement just completed which, in conjunction with double-tracking done during the last five years, has given the Canadian Pacific Railway two tracks all the way from Montreal to Toronto. The new line, built under the corporate name of the Campbellford, Lake Ontario & Western Railway, has ruling gradients of 0.4 per cent. each way, and takes the place of a second track along the old route through Havelock and Peterboro, which has ruling grades of 1.1 per cent in each direction that could not be reduced to 0.4 per cent except at a prohibitive cost. Incidentally the new line taps some new territory and touches a number of good-sized places on the shore of Lake Ontario that the Canadian Pacific has not hitherto reached.



Territory from Montreal to Toronto and Relation of New Route to Old Main Line of Canadian Pacific

OPERATING CONDITIONS

From Montreal to North Toronto via the old line the distance is 335.7 miles. The territory is shown on the accompanying map. For operating purposes there are three subdivisions, namely, from Montreal to Smith's Falls, 128.7 miles; from Smith's Falls to Havelock, 109.2 miles, and from Havelock to North Toronto, 97.8 miles. The first or Smith's Falls subdivisions, which carries the Winnipeg business as well as that between Montreal and Toronto, was first double-tracked, this work being completed late in 1909. The alignment on this section was already good and the ruling gradient of 1 per cent was reduced to 0.3 per cent eastbound and 0.4 per cent westbound.

Growth of business made some relief of the single track between Smith's Falls and North Toronto imperative. Surveys completed in 1911 developed the fact that even with long diversions it was impossible to reduce materially at any reasonable cost the gradients on the existing line, but it was found that on the new location shown between Glen Tay, 15.5 miles west of Smith's Falls, and Agincourt, 10.5 miles east of North Toronto, a new line 1.6 miles longer than the old, but with 0.4 per cent ruling grades each way, was feasible. The section from Smith's Falls to Glen Tay was double-tracked in 1911, this work being fairly light. Heavy grading was necessary between Agincourt and North Toronto in order to get the grades down to the desired maximum, and this portion of the double-tracking also entailed the construction of two large viaducts. This work was started last June, and is nearing completion.

NEW LINE

Starting from Glen Tay, the new line, after traversing a few miles of agricultural country, strikes into a rocky section, lightly timbered and abounding in lakes. In these 34 miles is the heaviest grading. Reaching an arm of Lake Ontario at Belleville, the route is near the shore until within 20 miles of Agincourt, and is situated in what is considered one of the best farming districts in Ontario. Seven important towns are reached, and particular attention has been paid to securing in each place a location favorable from a traffic standpoint.

This line is built with a maximum curve of 4 deg., spirals of 100 ft. in length per degree of curve being used in all cases. The average curvature is 20 deg. per mile. While the ruling gradients are virtually 0.4 per cent in each direction, velocity grades were used where economy suggested them. Curves are compensated 0.04 ft. per degree of central angle. Vertical curves are 100 ft. long per 0.05-per cent change of grade in sags and per 0.1-per cent change on summits. All grades at, approaching and leaving passing sidings are reduced to 0.3 per cent compensated for a distance of 3000 ft. from either end of the siding.

In general the right-of-way is 100 ft. wide. Embankments up to 16 ft. high are 16 ft. wide; higher ones are 18 ft. wide. Slopes of fills are 1½ to 1 for earth and 1¼ to 1 for rock. Earth and rock cuts are respectively 22 ft. wide, with 1½ to 1 slopes, and 20 ft. wide, with ¼ to 1 slopes. Both in the purchase of right-of-way and in the grading account was taken of the probability of future double-tracking, sufficient land for the purpose being bought where possible, embankments and cuts being made for the additional track in preference to wasting or borrowing material.

BRIDGES

All bridges and culverts are of concrete and steel construction. Of the steel structures the principal ones are that over the Ganeraska River at Port Hope, 1800 ft. long; that over the Trent River and Canal, 1493 ft. long; that over Mud Lake, 964 ft. long, and that over Dixie Creek, 916 ft. long. Most of these are of viaduct construction, with few spans greater than 90 ft.

The greatest difficulties were encountered at Mud Lake crossing, near the eastern end of the new line. Two 241-ft. trusses span the lake proper with a pier in the center. A short girder span leads to the top of the east bank, several viaduct spans constituting the west approach. The lake itself is only 2 or 3 ft. deep, but the bed is a mass of semi-liquid mud some 20 ft. deep, under which a thick stratum of blue clay, very soft at the top, and thin layers of sand, gravel and hardpan made it necessary to carry the center pier down to a depth of 103 ft. below the water level to reach solid rock. The pier on the west shore also had to be carried down 56 ft., and the next one 30 ft. These three piers were sunk under air pressure, using reinforced-concrete caissons with steel cutting edges.

The objection to grade crossings on this line is naturally not as acute as in more populous regions. Of seventeen railroad crossings and 293 highway crossings, seven and 225 respectively are at grade. For operating purposes Trenton, which is midway between Smith's Falls and North Toronto, has been made a division point, and a yard and shops have been built there. Passing sidings are 3000 ft. long and are about 6 miles apart. The track is laid on cedar, hemlock, tamarack and jack-pine ties in 18 in. of gravel ballast with 85-lb. rail.

Quantities on the work include 7,500,000 cu. yd. of grading, of which 1,300,000 cu. yd. were solid rock, 100,000 cu. yd. of masonry and 15,200,000 lb. of steel. The cost has conformed closely to the estimate, which was $11,000,000, or approximately $60,000 per mile. The work was done under the direction of C. W. P. Ramsey, engineer of construction, and P. B. Motley, engineer of bridges of the Canadian Pacific Railway.

A HOSE FOR A WATER MAIN served a section of the city of Paso Robles, Cal., for several days after the bridge carrying the regular supply had been washed out by the storm on Jan. 25. A rope was put across the river and a fire hose suspended from it. The hose sustained the pressure of the big pumps. Later on it was replaced with a 4-in. pipe suspended from three strands of ⅜-in. guy wire.

Engineering Features of the Panama-Pacific International Exposition

Part II—Discussion of Types of Building Construction, Loads, Allowable Unit Stresses, Foundation Material and Methods of Pile Support

By A. H. MARKWART
Assistant Director of Works

IN the matter of structural design for the buildings of the Panama-Pacific International Exposition there were furnished, in general, foundation plans, floor-framing plans, roof-framing plans and sufficient sections and elevations to show all framing. The contractors were required to furnish construction-detail drawings for approval and to this end the plans prepared by the structural bureau gave sufficient information to the contractors to enable them to prepare all details without computation for sizes of members and connections. In the few cases of buildings with a steel frame the details in accordance with the standards of present American practice as given by Carnegie or Cambria handbooks, or the American Bridge Company's standard details were used. In the case of timber and concrete construction connections were shown in more detail.

The structural bureau detailed an architectural engineer to work in conjunction with the associate architects to obtain complete information as to location of posts, wall lines and openings in wall, sections through cornices, and special architectural motives—in fact, all information necessary to prepare the drawings of the structural frame. All information was then turned over to structural squads and very rapid execution of contract drawings was the result. This method eliminated the annoying and contingent delays usually prevalent in the development of engineering plans in connection with architectural work. The scale for timber drawings in general is ½ in. to the foot, and for details of steel 1 in. to the foot.

GENERAL TYPE OF CONSTRUCTION

The buildings will be supported on pile or spread footings of wood, depending upon the nature of the soil. All buildings in the filled area will be upon piles. With the exception of buildings having a steel frame, all structures are of the usual exposition construction—a timber frame supporting a wall built of wooden studs, covered with sheathing and imitation marble. All exterior window openings are to be glazed with a chipped translucent glass instead of clear glass.

Walls.—The composition used for covering the exterior walls consists of a specially prepared gypsum product colored at the factory in accordance with formulæ furnished by the exposition company and manufactured in such a way as to be adapted particularly for exterior use. Where cast forms are not used the plastic composition is applied directly to the grooved sheathing.

Floors.—The floors in general are supported independently of the piers carrying the structural frame. They are composed of an under floor of 2-in. dressed shiplap, with a 1-in. dressed and matched floor in the aisles, supported on joists, girders, posts and spread or pile footings, as required. In the case of spread footings, joists are generally 2 x 8 in., 2 ft. on centers, with 9-ft. spans; girders are 6 x 8 in., with 9-ft. spans. In the case of pile footings, to obtain the full value of a pile, the joists are in general 2 x 12 in., 2 ft. on centers, with 14-ft. spans and girders 10 x 16 in. with 20-ft. spans.

Roofs.—The roofs are composed of 1-in. dressed shiplap, supported on the roof joists or rafters and purlins, in general 24 in. on centers. The roofing material consists of a prepared roofing with an asbestos top sheet, weighing 38 lb. to the square, and cemented to a layer of roofing felt, the felt being laid without cementing pitch. The asbestos surface is laid to the weather and will be painted with fire-retardant paint in desired colors to suit the adopted color scheme. About 20 per cent of all roof surfaces will be pierced for skylights, which will be glazed with ¼-in. ribbed and wired glass. Previous expositions have resorted to the use of translucent fabric for skylights and have used prepared roofing without the covering of asbestos. It is thought that in this instance greater protection from fire will be afforded than was obtained heretofore. In the design of roofs the line load was assumed to be 20 lb. per square foot on rafters and purlins and for bending in top chords of trusses.

For the buildings the assumed floor loads varied from 100 to 200 lb. per square foot, depending on the nature of the exhibits.

Wind was figured as 20 lb. per square foot of vertical walls, 150 ft. high and under, and 25 lb. for walls more than 150 ft. high, with roofs computed by Duchemin's formula for wind normal to roof, with $P = 30$ lb. per square foot.

All roof trusses were designed for the following two conditions: (1) Dead load plus 15 lb. live load per square foot, total dead and live load on truss not to be less than 35 lb. per square foot; (2) dead load plus wind load.

UNIT STRESSES

Special attention was paid to the determination of unit stresses to be used in wood, and after careful discussion an extreme fiber stress of 1500 lb. for cross-bending was adopted. This was exceeded in the case of certain floors. This may seem low in view of the temporary character of this construction, but, whether temporary or permanent, the loads must be cared for. All structural lumber used in connection with the construction was imported direct from the mills in the Northwest and was all fresh cut, the mill run and of the grade "merchantable." In a number of instances this merchantable material was such as would have caused its rejection had the work been of a more permanent character. The consideration of these facts resulted in the selection of the unit stress mentioned above.

The allowable stresses used in design are as called for in the general specifications for steel-frame mill buildings, as given in Milo S. Ketcham's "Steel Mill Buildings," modified as presented in the table.

COLUMNS AND SPLICES

Columns were considered as fixed at the ends, where provision could be made for providing the condition of fixedness as assumed. Special attention was paid to the transfer of web stresses to the flanges of columns to resist wind bending. Where bending due to wind occurs, the combined stress due to dead load and bending does not exceed the safe stress as given by the foregoing column formula, increased 25 per cent, considering the width of column in the plans of bending. The maximum ratio of length of timber to its least width is 60.

The general type of splice for tension is two wooden splice plates on either side of a main member with 2-in. Ohio pins. The value of one pin was taken at 800 lb. per linear inch. The total stress in the bolts through the splice plate on either side of the joint was considered equal to one-half the total stress transmitted by the splice. Where possible, splices were arranged so that pins were horizontal to prevent falling of pins due to shrinkage. A number of full-sized tests, using various materials for pins, were made to confirm the selection of this type of joint.

ALLOWABLE STRESSES IN TIMBER

Douglas Fir

	Lb. per sq. in.
Tension with grain	1,200
Compression and bearing	1,600
Compression across grain	350
Transverse, extreme fiber (except in floors, as later noted)	1,500
Modulus of elasticity, dead load	1,000,000
Modulus of elasticity, live load	1,500,000
Shearing with grain	150

Columns

For columns under 15 diameters .... $P = 1200$

For columns over 15 diameters .... $P = 1600 \times (1 = L)/60\,d$

P = allowable stress, lb. per sq. in. for centric loads.

L = length of member in inches.

d = least width member in inches.

Or column formula as per Cambria Steel handbook, with a working stress equal to one-third that given in table for Douglas fir.

The maximum length of timber to be used generally for chords of trusses was taken as 36 ft. A maximum length of 70 ft. was used in special cases.

All bolts and rods are supplied with cast-iron washers of special detail, except where the diameter of the washer was greater than the width of the timber, when steel plates were used of sufficient area to provide bearing against the grain of the wood at 350 lb. per square inch to the amount of the value of the rod in tension at 16,000 lb. per square inch.

All rods in trusses are of steel or refined iron, with upset ends not forged on, and computed at 16,000 lb. per square inch. All rods in trusses are assumed to have a 3000-lb. initial tension at 16,000 lb. per square inch. This is equivalent to an addition of 0.1875 sq. in. above areas required by stresses.

All joints of end posts of trusses with the lower chord have shoe plates with lugs, or other suitable connection, furnishing definite lines of action; but such joints were assumed to be simple joints and to depend upon only one type of detail for resistance. For example, if a shoe plate with lugs into the lower chord was used, these lugs were taken to furnish all resistance with none of the horizontal stress in the lower chord taken by the inclined bolts.

The area occupied by the main exhibit palaces was a tide flat in the early history of San Francisco. After the exposition's fill was completed a number of tests were conducted to determine the supporting power of the soil at the depth of what would probably be the spread footing bottom. The result of these tests indicated that the supporting power of the dredger sand was very low, about 400 lb. per square foot, which prohibited the use of this type of footing.

Pile tests were also made and it was found that the fill in settling gripped the piles in such a manner as to act as a load upon them. This caused the piles to penetrate into the original bottom, and the conclusion was reached that unless the piles were sufficiently long they would settle with, and more rapidly than, the fill when the superimposed load would be brought upon them. Therefore, after a careful investigation, the engineers were forced to the conclusion that it would be advisable to carry any given load by skin friction alone. The general character of the soil under the dredger fill was clay, mixed with blue mud and water, underlaid with a layer of green sand and clay, and finally, hardpan, the hardpan being located all the way from 30 to 120 ft. below the surface. In view of the great number of piles required, economy of length was an important factor, and it was finally decided to drive all the piles into the layer of green sand and clay overlying the hardpan to a 1-in. penetration at the last blow.

UNDERLYING SOIL

The character of the soil underlying the sites not covered with dredger fill was, in general, yellow beach sand, soft clay and sand, hard green sand and clay, and, finally, yellow hardpan, except in areas which had been filled prior to the commencement of exposition activities. It was decided to use in general piles for the support of all building walls and special loads in these areas as well as in the recently filled area. The reason for this was threefold—(1) uniformity of construction; (2) greater safety in case of earthquake, as portions of the site were originally submerged, and past experience in San Francisco indicated that structures were most affected when they were supported on spread or raft footings, and (3) in giving a value 3000 lb. per square foot to the sand it was found that a spread footing would cost as much if not more than a pile footing.

The actual length of pile driven throughout the site would vary from 16 to 75 ft., and in all cases an assumed load of 20 tons was taken as the value of one pile. This constant unit may seem queer, inasmuch as the value of the pile usually depends upon skin friction and length, but in the case in point tests were conducted which confirmed the selection of the amount named.

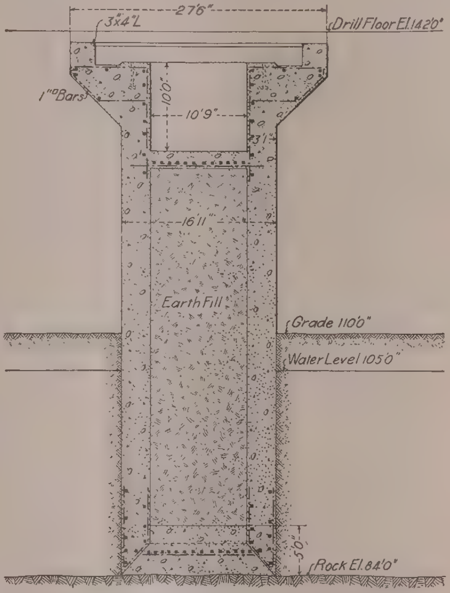
A LARGE PUMPING INSTALLATION is reported from the Argentine port Puerto Militar. Five centrifugal pumps, each with a capacity of 110,000 gal. per minute, are to be used in pumping water from a drydock with a capacity of 63,000,000 gal. The casing for the pumps is 15 ft. in diameter, and each unit is direct-connected with a 550-hp, two-cylinder compound steam engine. The period within which the drydock must be emptied is set at two hours and forty-five minutes.

Gun Platform Foundations

Sinking Sectional Concrete Caissons through Fine Sand by Open Excavation

THE concrete foundations for two gun and mortar platforms, 27½ ft. in diameter, in a New York armory were sunk about 20 ft. below ground-water level through fine sand to rock by the process of building up successive courses of the cylindrical footing above ground and excavating the interior, a method which was adopted after much more expensive and difficult systems, involving the use of open watertight cofferdams and pneumatic caissons, had been rejected.

The work was done at the Eighth District Coast Artillery Armory, Jerome Avenue and Kingsbridge Road, New York City. The site is in the old basin of the Jerome Park reservoir, where the ground surface lies about 25 ft. below the water level of the present reservoir, and the soil consists of fine and medium, clean water-bearing sand. Ground-water line is about 5 ft. below the surface and the architect's borings indicated rock at a depth of 26 ft. The gun platform is supported on a hollow cylindrical concrete shaft with an exterior diameter of about 17 ft. and an interior diameter of about 11 ft. It is reinforced, top and bottom, with 1-in. square vertical and circular horizontal bars, and has a continuous reinforced-concrete footing over the entire area of its base. The hollow concrete construction was adopted instead of wood or steel piling or caissons, because of its watertightness and assurance against caving-in of the earth and because the weight would be sufficient to sink it without additional loading.



Section of Gun Platform Foundation

METHOD OF CONSTRUCTION

The lower course of concrete, 3 ft. thick and 4 ft. high, was cast in a wooden form on the leveled surface of the ground and was provided with a reinforced cutting edge having an angle of about 45 deg. in vertical cross-section but not protected by the steel plates or angles frequently used in such cases. The form was made of vertical strips of 1⅛-in. yellow-pine boards fastened to 3-in. inside and outside scarf boards.

The second form was seated on top of the first form and after the concrete had set the lower form was removed and reassembled on top of the second one and so on, alternating them as the caisson was sunk. In this way the cutting edge descended to the surface of the rock, which was cleared off and covered with reinforced concrete 5 ft. thick to form a continuous footing, distributing the load over the entire area of the foundation. The interior was then back-filled with earth and sand up to the level of the reinforced-concrete gun floor which was bonded into the side of the caisson and the platform built in a special form.

The work was done under the direction of Brigadier-General S. W. Roessler, Corps of Engineers, U. S. A. Pilcher & Thachau were the architects. The Concrete & Foundation Company, of New York, was the contractor.

Cape Cod Canal Tolls

Tolls for the new Cape Cod Canal have been announced by the Boston, Cape Cod & New York Canal Company, which controls the canal. Vessels to which they apply will be grouped in three classes, as follows:

Class A: Yachts, motorboats and vessels not engaged in commercial trade and Government vessels shown in Government books under gross tonnage.

Class B: Vessels engaged in commercial trade carrying passengers only, passengers and freight, and miscellaneous freight or in ballast.

Class C: Vessels carrying crude material in bulk cargo lots.

Vessels again are divided into (1) those less than 16 gross tons based on length over all, (2) vessels over 16 gross tons and (3) vessels over 1000 gross tons.

Tolls on vessels in Class A range from $3, starting from a minimum less than 15 ft., to $100 for vessels of 950 to 999 tons.

In Class B the minimum is $8 and the scale goes up similarly to $100. In both Classes A and B vessels over 1000 gross tons will be charged 10 cents per gross ton per single passage.

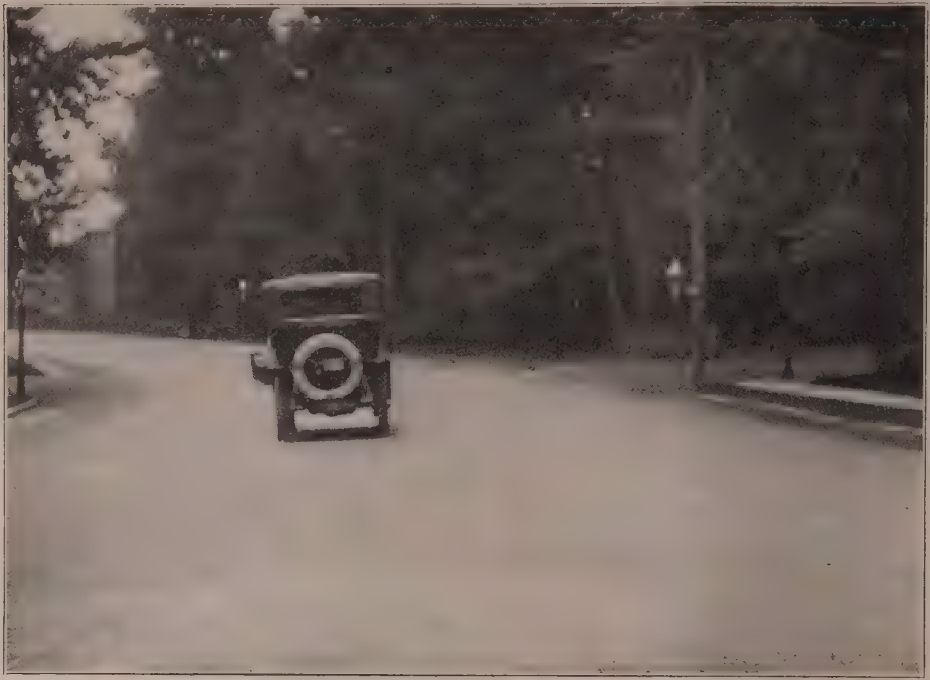
Class C covers vessels with and without cargo. The minimum toll is $6, starting with a minimum length of 25 to 29 ft. For ships in ballast $3 is the charge.

Vessels over 500 gross tons will be charged on the basis of their having on board 800 tons of cargo at 7 cents per cargo ton per single passage. Vessels having on board over 800 cargo tons will be charged 7 cents per cargo ton per single passage, and vessels over 500 gross tons without cargo will be charged 5 cents per gross ton per single passage.

The total tonnage of cargo in vessels in tow will be computed as if on board a single vessel. Tolls include the towing tug provided by the owners of barges or schooners.

Vessels carrying cargo by measurement must reduce it to tons.

WOODEN FORMS FOR CONCRETE were used fifteen or twenty times by the E. E. Smith Company, contractor for two sections of the four-track subway in Brooklyn. They were easily removable in panels, and in cold weather were washed with hot water immediately before placing the concrete. All of the cross bracing was set so as to serve for bracing the forms as well as the outside sheeting, and the upper transverse braces were cambered parallel with the cross-section of the roadway.



Waterbound-Macadam Pavement Maintained by Bituminous Surface Treatment

Achievements of Philadelphia Highway Bureau for 1913

Commissioner Connell Reports Progress Made by New Engineering Administration—More Complete Records, Improved Granite Pavements and Resurfacing by City Forces

CULLED from the annual report of the Philadelphia Bureau of Highways and Street Cleaning, the following remarks indicate the work done during 1913, including many items which support the statement that greater efficiency has followed the reorganization of the department along engineering lines. William H. Connell is chief of the bureau and William D. Uhler is the principal assistant.

All grading, paving, repaving, surfacing and resurfacing done by contract are being recorded on contract cards, which show in detail the complete history of each contract from the time of the passing of the authorizing ordinance until completion. It is now possible to get all information as to quantities, costs, etc., of contract work, as well as to the completion of substructures on any given contract, without having to refer to a number of book records, as was formerly necessary.

A system of block and intersection card records will be put into effect early in 1914, permitting the compilation of a complete history of the original paving of each block and intersection in the city, together with the maintenance data of all pavements laid since Jan. 1, 1912. The reverse side of each card will be used for a sketch of the block or intersection noted on the front and will show each patch as made, together with necessary explanatory remarks. It will thus be possible to determine the proper policy to pursue with regard to continuing the repairs to a certain street, repaving it, or changing the character of pavement.

PRINCIPAL COST ITEMS

During the year there were 512 contracts in force for the construction and maintenance of pavements and country roads, grading streets and roads, collection and disposal of garbage, ashes and household waste, street cleaning, and the maintenance of bridges and sewers. The total amount of these contracts is $5,785,416.56, on which $4,770,889.22 was expended during 1913. In addition, $696,892.13 was spent for work done by the city forces on the maintenance of streets and roads, bridges and sewers, making a total of $5,467,781.35 expended by the bureau. There were also 133 contracts, aggregating $687,623.47, on which bids were received and physical work was not begun.

The mileage of heavy pavements constructed was 23.60; of bituminous macadam roads, 12.99; of waterbound macadam roads, 14.35, and of dirt roads graded, 20.31—bringing the total mileage of heavy pavements to 1072.67, of bituminous macadam roads to 60.98, of waterbound macadam to 242.10—a total of 1375.75 miles of paved streets and roads and 250 miles of dirt roads. A statement of the mileage and yardage of the various types of pavements is shown in the accompanying table.

Comparison of the amount of work performed during 1913 with former years, as shown by the costs, discloses the fact that the work actually done exceeds the average amount per year in the eight preceding years by 48 per cent, being 3 per cent more than the largest and 103 per cent more than the smallest amount done in any one year. That such an increased amount of work could be controlled and inspected by a force which was not proportionately augmented is an indication of the increased efficiency of the staff of engineers now directing the bureau.

An important contract was that for repaving Market Street from the west end of the Schuylkill River bridge to Lancaster Avenue. This street, which is subjected to extremely heavy traffic, was formerly paved with old and very rough granite blocks, which have been replaced with a granite-block pavement, the first laid in Philadelphia conforming to the best standards for this class of work. It forms a pavement almost as smooth and as easily cleaned as asphalt and yet sufficiently durable to withstand the wear of heavy traffic.

Another improvement that has received considerable attention in the business section of the city was the substituting of modern dressed granite blocks for wood blocks at the intersections of the street-railway tracks on Market and Arch Streets. The wood-block pavement at these intersections was constantly being repaired and seldom lasted more than six months. Aside from the severe test imposed on wood block by intersections, the track construction in the city causes extreme vibration of the rails, as the ties are simply laid on the ordinary subsoil on the bed of the street. There should be some regulation, states the report, compelling the railway companies to adopt a modern standard method of construction.

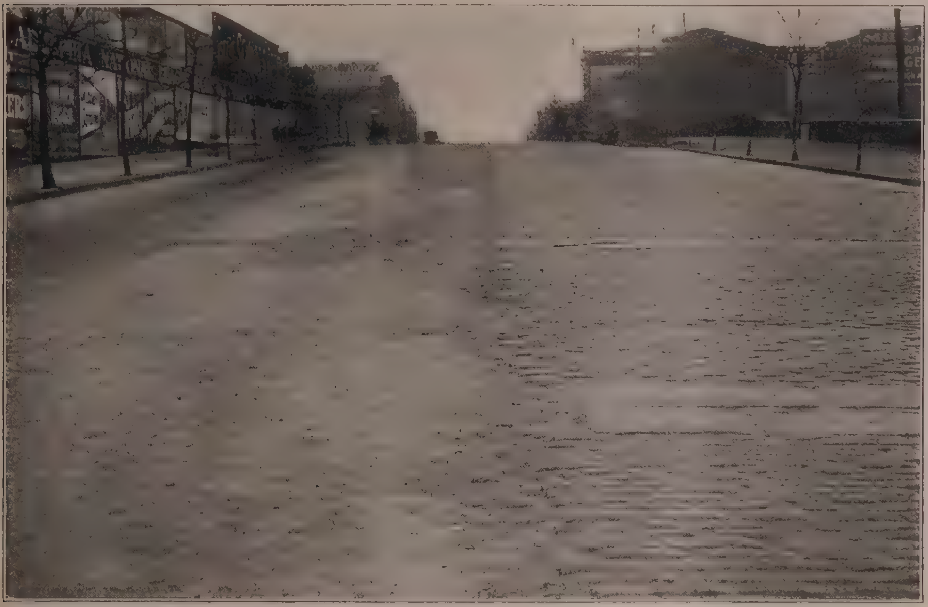
REPAIRS BY CITY FORCES

As it was realized that the resurfacing of waterbound macadam roads—a program which now comprehends nearly all of the main thoroughfares—could not be well specified or estimated in advance, practically all this work was performed directly by city forces. Of macadam roads 30.57 miles were resurfaced, at an average cost of 46 cents per square yard, which is considerably less than the average cost for 7.28 miles resurfaced by contracts—64 cents. There were also 201,674 sq. yd. of macadam patched at an average cost of 26 cents per square yard. The same policy has been adopted in repairs to granite and vitrified-block pavements, and as a result not only has the average cost been reduced to 40 cents per square yard, but the work has been performed in a much more expeditious manner.

It is especially desirable, to quote the report, that arrangements be made whereby all of the maintenance and repair work of

Granite Blocks at Trolley-Track Intersection at Market and Arch Streets the city will be performed directly by city forces, as work of this character can be done in a more efficient and economical manner by day labor than by the contract system, which is borne out not only by events of the last two years, but by the experience of all the leading municipalities throughout the country. The small equipment owned by the city at the present time for repairs to asphalt streets should be greatly increased.

The practice adopted in connection with bituminous-surface treatments consisted of applying from ¼ to ½ gal. of bituminous material per square yard and spreading over the surface from 15 to 30 lb. of fine washed gravel or clean trap-rock chips, the quantity and character of materials depending upon the condition of the road, the nature and character of traffic to which it is subjected, grades, and local and social conditions. In 1912 none of the macadam roads were in a condition fit for applying bituminous-surface treatments until after they had been resurfaced or repaired late in the season; consequently most of the bituminous material used consisted merely of a dust-laying material and was applied to roads in poor repair simply for the purpose of laying the dust. In 1913 a more permanent character of bituminous material was used, which not only does away with the dust nuisance but is designed to preserve the roads, and if the policy adopted is continued and similar material applied when necessary, according to Mr. Connell, about 200 miles of macadam roads can be placed in first-class condition and maintained almost indefinitely at a very low cost. During the year 40.81 miles of roads were placed in first-class condition through the application of bituminous-surface treatments at an average cost of 7.3 cents per square yard.



Standard and Antiquated Granite Pavements Side by Side in Philadelphia

STATISTICS OF ROADS IN PHILADELPHIA ON DEC. 31, 1913.

Character	Miles	Sq. yd.
Granite block	348.32	6,573,246
Sheet asphalt	504.57	7,457,393
Asphalt block	7.39	69,950
Vitrified block	171.57	2,517,755
Wood block	9.90	224,650
Cobble	7.13	73,704
Rubble	4.63	65,213
Slag block	8.13	78,071
Cement and granolithic	11.03	54,242
Total	1072.67	17,114,224
Bituminous macadam roads	60.98	703,548
Waterbound macadam roads	242.10	2,799,488
Total	303.08	3,503,036
Grand total (improved pavements and macadam roads)	1375.75	20,617,260

Progress Report on Floods and Flood Prevention

Presented to the Baltimore Convention of the American Society of Civil Engineers

THE special committee on floods, flood prevention and allied subjects of the American Society of Civil Engineers presented the following progress report at the Baltimore Convention, June 2, 1914:

The recent floods of exceptional magnitude, which in several instances became serious calamities, have made the entire Nation alive to the necessity of action looking toward flood prevention. Due to unavoidable delays in the organization of the committee it has only been practicable to submit at this meeting a progress report outlining in general the proposed scope of the committee's investigations.

PERIOD OF INVESTIGATION

It is not expected that any universal solution for the prevention of floods and the mitigation of attendant disasters can be formulated. Furthermore, it is believed that, however earnestly conclusions are now desired, a period of investigation is absolutely necessary, and that before the committee can present its final report it must devote its efforts to the compilation of fundamental data.

There is much information to be collected, in this and other countries, relating to the frequency and magnitude of floods and to the seriousness of the losses resulting therefrom. Consideration should also be given to the obstruction of natural flood plains which have resulted from community growth on river banks and from other activities.

The subject of flood prevention is a broad one, closely allied to the general question of stream regulation. It is therefore deemed advisable to emphasize certain definite phases of the problem with special reference to the relation which runoff and the maximum-stream flow bear to rainfall intensity and distribution, and in this connection to give attention to such vital questions as the effect of forests and of storage reservoirs upon runoff and maximum stream discharge.

The committee appreciates the value of uniform, accurate and continuous records and desires to call attention to the insufficiency of data heretofore collected relating to stream flow, particularly under flood conditions. Data of this character should be systematically collected by Federal and State agencies. While commending what has already been done along these lines, the committee believes that more ample provision should be made for the observation and study of floods during their occurrence.

The engineer of to-day is in urgent need of the data relating to the floods of the past, but in many cases the opportunity to obtain this data has been forever lost. Fifty years hence the data of to-day will be no less essential.

Your committee feels that the profession should keep in touch with legislation affecting stream regulation and flood control. It is, therefore, proposed to review the work now being done in the several States relating to floods and allied problems and to cooperate with the society's committee on water laws.

SUB-ORGANIZATION OF COMMITTEE

As the members of the committee live in widely separated sections of the country, making it impracticable for all, or even a majority of them, to meet with any degree of frequency, several subcommittees have been appointed to take charge of the work in their respective localities.

These subcommittees are as follows:

Rivers Emptying into the Atlantic Ocean—John A. Bensel, Arthur T. Safford and Charles Saville.

Ohio River and Tributaries—John A. Ockerson, Morris Knowles and Daniel W. Mead.

Rivers Emptying into the Gulf of Mexico —C. McD. Townsend, T. G. Dabney and Frank M. Kerr.

Rivers Emptying into the Pacific Ocean —C. E. Grunsky, J. B. Lippincott and F. L. Sellew.

Other subcommittees will be appointed, as occasion may show to be desirable, to take charge of special work.

Your committee hopes to be able to report substantial progress at the annual meeting in January, 1915.

Bridge Collapse at Bluffton, Indiana

COLLAPSE of another railroad bridge temporarily repaired after the floods of the spring of 1913 has been recorded. On May 22 an engine and one car carried down a 53-ft. steel deck-girder span at Bluffton, Ind., where the Cincinnati, Bluffton & Chicago Railroad crosses the Wabash River. The engineman was killed and the fireman injured. John C. Curtis, receiver and general manager of the road, writes that the span which went down rested on five piles driven to bedrock at each end. Capping the piles was a 14-in. white-oak timber. Water under the bridge was from 6 to 8 ft. deep, and it is believed that the earth holding the piles had been washed away, allowing them to collapse. The bridge, however, says Mr. Curtis, showed no signs of weakness prior to the accident.

Status of Engineering Organization in the United States

Extracts from the Presidential Address of Hunter McDonald before the Baltimore Convention of the American Society of Civil Engineers, June 2, 1914

It is a matter of pride and cause for congratulation that the most stupendous work of civilization, the Panama Canal, is about to be presented to our Government by men of our profession, completed greatly in advance of the time when it was due and absolutely free from any taint of scandal, graft or incompetency in any of the stages of its progress.

Fresh from the glories of this achievement our Government has entered upon two more gigantic tasks to be performed in untried fields. These are the valuation of the railroad and telegraph properties of the United States and the building of railroads in Alaska. The first of these projects is engaging the thought and time of a large number of our profession. In this work engineers have the opportunity to show to the country that they, more than any politician or lawyer, are qualified to ascertain and fix the underlying principles upon which this valuation should be made, and then to follow this up by the actual working out of the results.

A commission of engineers is now charged with the duty of selecting a route for the main line of a railroad from some harbor on the southern coast to the central part of Alaska and to determine what and where branches are to be built. When the location is determined it is probable that the building of the roads will be intrusted to the Corps of Engineers of the Army. It seems improbable that the roads will ever be operated by any agency other than the National Government. An opportunity presents itself here for civil engineers to demonstrate their fitness for responsibilities other than the mere application of mathematics. A civil engineer is now Governor of the Canal Zone, and another should be general manager of the Alaskan Railroad when the time for its operation arrives. It goes without saying that his staff should be composed of engineers. An engineer has recently been chosen as manager of one of our large cities. Many are being placed on city commissions.

Persons who are charged with the responsibility for the wise expenditure of public money are more and more inclined to turn to the engineer for advice as to how to do it, and to recognize the fact that civil engineers are fit for something else besides the preparation of blueprints, setting stakes and running instruments. We are now upon the threshold of new responsibilities and we must set ourselves faithfully to the task of preparing to meet them. Good engineering consists largely in meeting emergencies with the resources at one's disposal. The man who does it is always in demand.

Use of Term "Civil Engineer"

[Mr. McDonald then took up in detail the derivation of the term "engineer" and its meaning at different periods, this discussion being introductory to a consideration of the condition in which the profession finds itself in this country to-day.]

There is ample evidence that the word "engineer" is now applied alike to the designers of engineering works and to the operators of engines. It is also evident that civil engineering is now considered by many to be a branch of engineering. In the language of Grover Cleveland, "it is a condition and not a theory which confronts us."

We could not, if we desired, compel the public to call locomotive engineers "enginemen or engine drivers"; nor stationary engineers, "power superintendents," notwithstanding the fact that such they are.

Conscious of our pre-eminence, this society has been content to sit still and let the branches of our profession grow up independently until they have become of such importance as to force us to accept the meaning of the word "civil engineer" as indicating a specialty or division of the profession. This is a false position and we alone are responsible for it. Smeaton evidently intended to make it a specialty, but he could not have known at the time he referred to it how intricate the divisions of the specialty were to become. Had we pursued a course similar to that of the engineers of Germany we would not to-day find ourselves in the humiliating position of being asked to substitute the word "professional" for the word "civil," in the bill recently pending before the New York Legislature for the regulation of the practice of civil engineering, before the other societies would co-operate with us in securing a bill which would be acceptable to the entire profession.

I have alluded to the status of the profession in Germany and will now describe its condition more at length, also referring briefly to conditions that exist in a few other countries. This is done with a view of comparing conditions in these countries with those in our own.

Verein Deutscher Ingenieure

[Mr. McDonald then summarized an article which appeared in "Engineering," London, Dec. 20, 1912. It was reprinted in the Engineering Record Jan. 25, 1913, page 104. Only part of Mr. McDonald's summary is here given.]

The society has a membership of over 24,000. The backbone of the organization is the journal. In 1911 it had 2200 pages of text, exclusive of the advertisements. News and proceedings of local sections are published. Books are reviewed with conscientiousness. Brief abstracts are given of important articles in over sixty leading journals. They follow closely on the article itself and are then reprinted on one side of the sheet, with room for marginal notes. Much space is devoted to correspondence. Original researches are encouraged and grants made from the general fund therefor. Medals are awarded for specially good work, and bad work is not permitted.

In the supplement to the journal questions of financial, political, economical and literary news are treated. The general aim of the supplement is to afford the engineer knowledge of the wider world which he serves and to bring the needs of the engineering world before sociologists, economists and politicians. "The enormous number of members and the influential positions which many of them hold make the Verein a power in the land with a voice for the industrial elements, such as no other country possesses." It has had great influence on technical education, and has banished Latin and Greek from the curriculum.

A new movement to inject engineering ideas into municipal and State administrations has been inaugurated and is meeting with great success. The framing of patent laws and the purification of technical language has received attention. It has fixed mechanical standards as well as fees for engineers and architects. Needy members are assisted with charity. No correspondence tuition is allowed to be advertised in the journal. Branches in foreign countries are contemplated.

I have dwelt at considerable length on the abstract of this article because it shows what might have been accomplished in this country had the management of our society shown the same interest in the profession at large as it has in the welfare of its members only.

French and British Societies

In France the good of the entire profession has always been the object of the Société des Ingenieure Civils de France, which is the title of the organization of the free engineers as distinguished from that of the Engineers des Pons et Chausses and other Government engineers. This society was founded in 1848. Its avowed objects are:

(1) To throw light by discussion on obscure questions in civil engineering; (2) to assist in aiding the development of applied science auxiliary to civil engineering and to assist industries; (3) to extend professional teaching among workmen and shop foremen; (4) to investigate questions of industrial economy of administration, to increase power production and wealth of the country; (5) to insure close relations among its members; (6) to act as a kind of employment bureau for its members; (7) to establish a fund in case of necessity.

An examination of the year-book of the society indicates a very prosperous condition, both as to finance and membership. The members are scattered over many colonies and foreign countries. Sections exist in all provinces.

The organization of the Institution of Civil Engineers, of Great Britain, is very similar to our own, and its status is so well known as not to require detailed reference here. All members admitted below the grade of member are required to pass examinations. The list contains the names of more than 9000 members of all grades.

Canadian Society of Civil Engineers

The Canadian Society of Civil Engineers was organized in 1887. Its objects are:

(1) To facilitate the acquirement and exchange of professional knowledge among its members, and (2) to encourage original investigation.

This society conceives civil engineering as embracing all engineering activity. The standard of membership is not as high as in the institution or our society, but candidates who are not graduates of recognized technical colleges are required to pass examinations. It is divided into four sections—electrical, mechanical, mining and general. Note the absence of civil. Provision is made for branches in important centers. They have a published code of ethics, and in two provinces, Manitoba and Quebec, the practice of engineering is limited by law to members of the society. Efforts are in progress to secure similar laws in all other provinces. The list shows 2627 members of all grades.

NEEDS OF THE AMERICAN SOCIETY

Members need no description of our own organization. While our growth has been phenomenal, and the standard of our membership generally maintained at a high level, there is a widespread feeling that there is something wrong and that we are not accomplishing the good there is in us.

Our total membership in all grades is over 7400. I believe there are fully 40,000 men in the United States who are eligible for various grades of membership. It is hardly safe to assume that the reason they are not members is because they cannot afford to be. I think it is safe to assume that while they value the prestige of membership, they feel that the benefits are too remote. The engineer's calling generally imposes isolation, and yet they all dearly love companionship and exchange of ideas with one another.

What we need and ought to have is the establishment of State organizations and of sections in all important cities. This matter has been studied by a special committee and discussed at one of our annual meetings, but because we felt that our duty ended with the welfare of our own members, as provided in the constitution, the project met with no encouragement. It is true that we permit local members in large cities to band together and call themselves associations of members, but they, as organizations, have no voice in our government, cannot mingle with other local organizations, and, except in very large cities where no other sections already exist, the formation of prosperous associations is impossible. The history of such local associations is by no means flattering to our pride or good management.

DEVELOPMENT OF LOCAL ORGANIZATIONS

The result of our narrow policy has been that organizations, embracing members of all the callings allied to civil engineering, have sprung up in nearly all cities of 100,000 inhabitants, and other national engineering societies have their own local sections established in many of these centers, and are co-operating with other local organizations. Some of these societies are by no means local in scope. In the independent local organizations the membership in many instances has not been of so high a standard as our own because of the necessity for a large membership in order to meet expenses, and, like the German and Canadian societies, all classes are taken in. Nearly all of these organizations contain some of our members, who have joined sometimes as a matter of civic pride and more often because they found at home that companionship which could not reach them through the medium of our transactions from New York. All but a few of these local organizations are struggling for existence and are unable to publish their papers and discussions. Some are prosperous, and one in Boston antedates our own organization by several years. It is the duty of this society to extend a helping hand to all who need it and to take the initiative in an effort to gradually amalgamate all engineering organizations into one homogeneous and co-operative mass, permitting each, as far as possible, to retain its name and identity. Some sacrifice on the part of all would no doubt be necessary. Union has not been possible among religious sects, but as I have heretofore shown engineers are of necessity managers and with their spirit of fair play and good sense ought to be able to get together. Call it what you will, the American Engineer Confederation, or, better still, the American Confederation of Civil Engineers.

I would not lower our standard of requirement for membership, but by extending local societies limited financial assistance where needed we can raise the general standard, and, in doing so, can so elevate the profession at large as to make a printed code of ethics unnecessary.

PARTICIPATION IN PUBLIC AFFAIRS

The time has come for the engineer to possess his own. The public is awake to the advantages of sound engineering advice. We have it in our power, without taking sides in political contests, to exert a beneficial influence in National, State and municipal affairs.

We should make use of the secular press in all legitimate ways in order to bring before the minds of the public at large the importance of the engineer in civil life. Whenever we let the people know that we are organized, not only for our own improvement and protection, but for the public good we need have no fear of not receiving proper consideration. We are wont to twit our medical friends on the fact that they often bury their mistakes while ours stand to plague us, but we dare not compare records with them on charities and patriotism.

It is not here contended that we should, as individuals, render free service, but that organized action should be taken on all matters where engineering advice will be useful in shaping public policy. Such organized action will bring about recognition of the engineer and stimulate demand for engineering advice.

THE SOCIETY'S HOUSE

Before undertaking to show others what they ought to do, we should first put our own house in order. Good engineering is good management. From our financial statement it would appear that we are in a very prosperous condition, which is no doubt true, and I wish to congratulate our past management on its wisdom and foresight in this respect. But are we getting all that we can get out of our present resources?

Our society house is located in what is fast becoming the business district of New York City. The present value of the land and building is not less than $600,000. Two large rooms are maintained as auditorium and assembly room respectively and used once every two weeks by an average of about 175 persons and once a year by about 700. They are too large to be comfortable for small gatherings. About twenty-five persons are generally employed in the building. Interest on the value of the property at 5 per cent makes the rental we pay for these privileges about $30,000 per annum. It would seem possible and wise to issue bonds and erect a building, portions of which could be rented for a sufficient amount to pay our interest, establish a sinking fund and give us rent free. The upper floors should be rented preferably to engineer tenants, the street floor to merchants, the top floor of the building would supply our offices, auditoriums and perhaps a roof garden. The architectural possibilities should atone for any fancied law of dignity. Using elevators nowadays is not considered a hardship. The amount now devoted to rent would go very far in aiding struggling local sections.

Pending the working out of these larger problems there are minor steps which can be taken at once which will add to the value of our membership.

CHANGES IN PUBLICATIONS

The volume now called "Constitution and List of Members" should be published in the form of a year book, containing all that it now contains, and in addition thereto a codification of the by-laws which have been passed from time to time by the board of direction and are subject to change by it. There are other matters of general interest which might be profitably included.

The minutes of our society are now published in the "Proceedings." Few of the members preserve the "Proceedings" because most of the papers therein are duplicated in the "Transactions." More important items of the "Proceedings," including the minutes of the board of direction and annual meetings and conventions, should be included in the year-book, and would thereby be preserved without compelling the binding and preservation of expensive volumes of "Proceedings."

The classification of membership which the secretary has inaugurated should be a regular annual feature and each member requested to return his calling at the same time as he does his address. Steps should be taken to provide automatically for transfer to the associate class of all members who abandon engineering practice and devote themselves exclusively to the promotion or sale of patented articles and appliances.

The provisions for expelling members guilty of improper conduct should be made less complicated and the power be placed in the hands of the board of direction. The board of direction should be empowered and required to espouse the cause of any member who is the subject of unjust attack. Fees should be paid members for creditable extracts of engineering articles appearing in our publication, and the advisability of continuing the monthly notes of important engineering articles now published in the "Proceedings" should be investigated.

I am not now prepared to suggest methods by which the ideals which I have heretofore rather vaguely outlined may be brought into realization, but I feel that whenever a thing ought to be done a way can be found to do it, and I believe a representative committee of our society should be appointed to study what we ought to do and how to accomplish it.

GROSS OPERATING REVENUES for February and March on the large railroads of the United States were $900.17 and $1,076.21 respectively per mile of road operated, as compared with $1,011.22 and $1,081.21 for the corresponding months last year, and $963.63 and $1,051.04 for 1912. Operating expenses per mile for the two months were $728.83 and $782.38 this year, $752.37 and $799.18 last year and $710.13 and $746.24 in 1912. This leaves as net operating revenue per mile $171.34 and $293.83 for February and March of this year, as against $258.85 and $282.03 for February and March, 1913, and $253.50 and $304.80 for February and March, 1912. The operating ratios for February and March, 1914, were 80.97 and 72.70 respectively, that for January having been 77.25.

Pile Foundations for Large Railway Shops

Three Thousand Concrete Piles, Aggregating 50,000 Linear Feet, Were Used for Substructure of Buildings of Boston & Maine Railroad

REPAIR shops covering 450 acres of land have recently been completed for the Boston & Maine Railroad at Billerica, Mass. These shops are among the largest in New England and their capacity for overhauling and repairing is thirty locomotives and 175 passenger cars per month. In all about 17 miles of track have been laid out at the site. The accompanying drawing shows the general arrangement of tracks and buildings.

Of the main buildings the two-story locomotive repair and machine shop is the largest in plan. To the east of this building is the locomotive blacksmith's shop. North of the locomotive shop is the office and storehouse building and east of the locomotive repair shop is the power house. To the north of this group is another group of buildings, centered about the car shop and paint shop. Between these is the transfer table for moving cars from one track to another. Besides the ten larger buildings there are many smaller ones, including the stripping shed, iron shed, dry kiln, dry-lumber shed, paint, varnish and oil houses, water tank, scrap bins, etc. All of the main buildings are supported on concrete-pile foundations and are of brick with steel framing.

NATURE OF SITE

The natural ground is in general of a sandy nature overlying a water-bearing sand or gravel. A portion of the top soil is mud or peat of varying depth. All filling of low places was made with sand taken from cuts at the same site. The ground-water level is about 8 ft. below the established grade. The old Middlesex canal originally ran from west to east through the northeastern end of the site. It was deflected to the north and east around the yards and through a culvert under the tracks connecting with the main line to Boston. From the culvert the water is allowed to resume its own channel. Cold Brook originally flowed through the center of the site. The brook was deflected into a ditch constructed at the east.

After the formation of the ground had been investigated by wash borings estimates for various types of foundation were made and it was finally decided to use concrete pedestal piles. The railroad engineers had originally specified a permissible load of 25 tons per concrete pile, but when pedestal piles were decided upon this load was increased to 30 tons for live load or 35 tons for dead load. The contract is believed to be one of the largest concrete-pile jobs ever undertaken in the East. Three drivers were continually at work and four drivers were used part of the time. One mixer handled the concrete for piles and one for caps. The piles varied in length from 9 to 30 ft. The largest day's run on three drivers was seventy-seven piles. The total number of piles driven was about 3000, and the approximate length of piling 50,000 ft. Besides the driving of piles, the foundation contractor formed all pile caps and piers and in addition placed a considerable volume of reinforced concrete.

LOCOMOTIVE MACHINE AND ERECTING SHOP

The length of the locomotive machine and erecting shop is 838½ ft., the width 160 ft. For approximately two-thirds of the length of the building, from bay 1 to 26, there are two inside rows of columns, while for the remaining length of the building only the central row of columns is continued. The load to be carried is a combination of dead and live loads. The shop will be served by two 65-ton traveling cranes capable of picking up the heaviest locomotive, two 10-ton traveling cranes with 75-ft. span and one 35-ton crane serving the whole floor of the machine shop. Piles were driven in practically every case on 3-ft. centers, and the pile caps were made 3½ ft. high with a reinforcing of old rails laid both ways across the tops of the piles. Considerable variation occurs in the reinforcing on some of the special caps. On the line of the walls two rails were laid between the pile caps, as shown.

The locomotive blacksmith shop is 332½ x 90 ft. in plan. The foundations were similar in general plan to those for the locomotive machine and erecting shop. The column loads were considerably lighter. Groups of three piles carry the column load in the side walls and groups of two piles at the end columns.

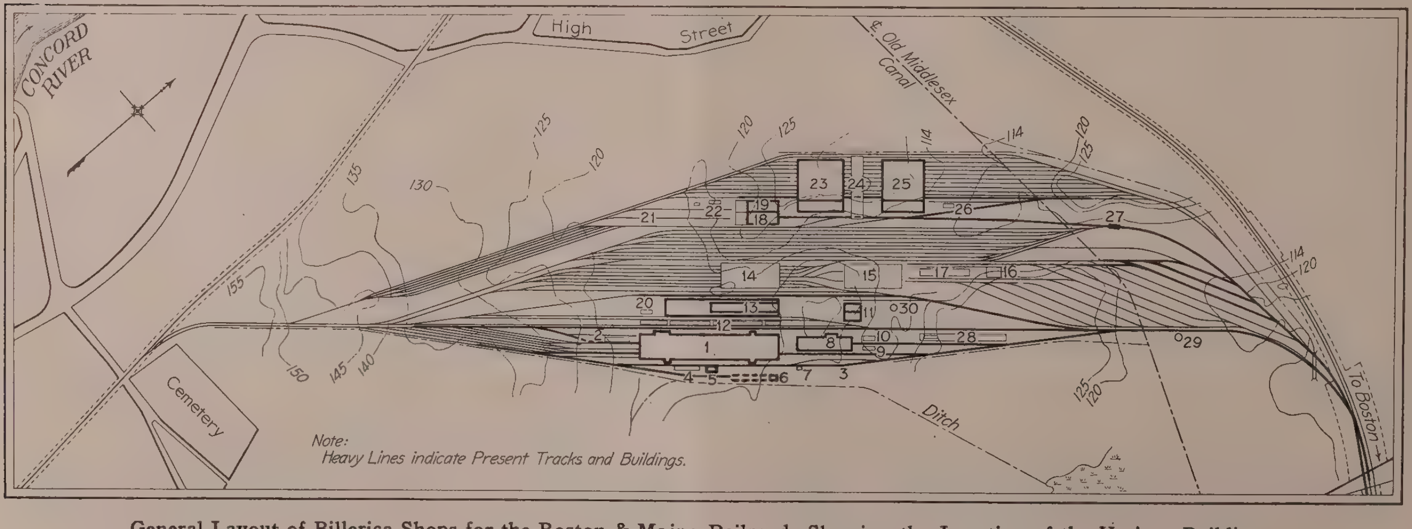
TIRE HOUSE

The tire house proper is a small structure, but a 300-ft. crane runway leads in one direction and a 40-ft. trolley runway in another. The footings for the tire-house bents and for the crane runway supports are shown in the accompanying detail. Instead of old steel rails the reinforcement in these piers consisted of ⅝-in. circular rods laid on both horizontal directions, with additional vertical reinforcing extending 15 ft. down into the pile and curved over into a hook in the pile cap. The two piles at the base of the pile cap have four reinforcing rods, and the pile at the apex in the case of the tire footing has eight reinforcing rods, and in the case of the runway support footing, six rods.

LYE VAT HOUSE

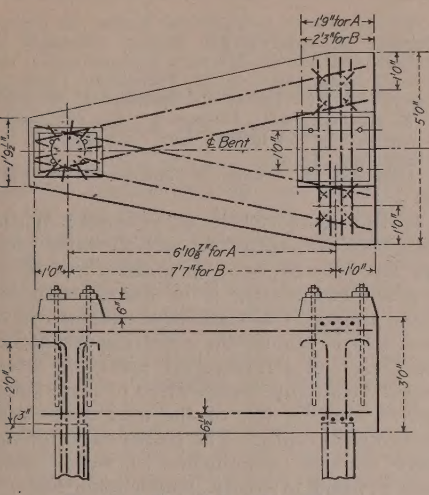
The lye vat house is 68 x 33 ft. in plan and contains two large vats. The section shows these as originally designed. The floor was at first 6 in., but this was later increased to 12 in. The heavy pressure from springs, however, broke through the floor and it was impossible to make it watertight. The concrete was then removed where soft, the floor grouted to a level and tar paper laid over the whole area with a covering of 2 in. of hot pitch. About 2 in. of concrete were placed over this and covered with 60-lb. old steel rails spaced 3 ft. on centers, with the ends embedded under the side walls. About 6 in. of concrete were then placed over the entire surface, rails and all. This made the thickness of the floor about 18 in. The vat was finally waterproofed with solutions of soap and alum of the following mixture: ¾ lb. soap to 1 gal. of water and ½ lb. alum to 4 gal. of water. Four coats of each solution were applied at intervals of twenty-four hours, beginning with the soap solution, which was applied boiling hot. The alum was applied at about 50 deg. Fahr.

The remaining buildings in the group around the locomotive shop are the office, storehouse and power house. The wall columns are supported by piers of four piles



General Layout of Billerica Shops for the Boston & Maine Railroad, Showing the Location of the Various Buildings

1, Locomotive shop; 2, Flue rack and boiler iron storage platform; 3, Locomotive coaling plant and cinder pit; 4, Stripping shed; 5, Lye-vat house; 6, Tire house; 7, Crude-oil tanks; 8, Blacksmith shop; 9, Coal and sand storage; 10, Iron shed; 11, Power house; 12, Castings platform; 13, Office and storehouse; 14, Freight-car shop; 15, Planing mill; 16, Kiln; 17, Dry-lumber shed; 18, Car machine shop; 19, Car blacksmith shop; 20, Oil house; 21, Depressed wheel-loading track; 22, Iron shed; 23, Passenger-car shop; 24, Transfer pit; 25, Paint shop; 26, Paint, varnish and oil house; 27, Track scales; 28, Scrap bins; 29, Water tank; 30, Pressure tank for sprinkler system.



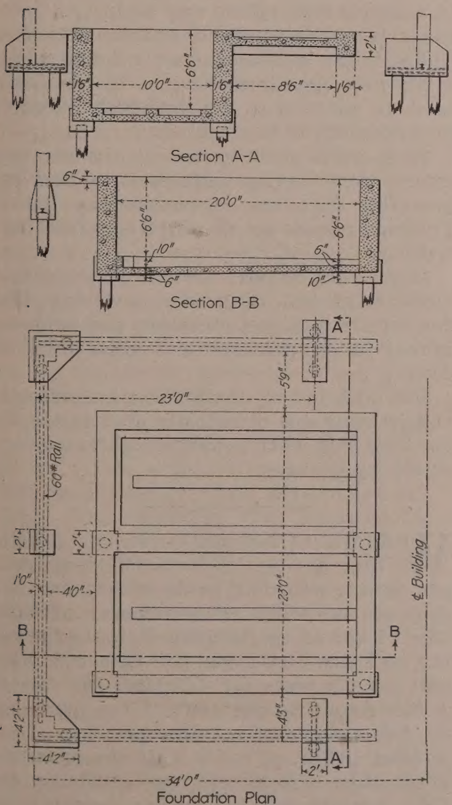
Footing Detail for Tire House

and the boilers, compressors, engines, turbines and various other machinery by independent pile foundations shown.

CAR SHOP, PAINT SHOP AND TRANSFER PIT

To the north the buildings are grouped about the car shop, paint shop and the transfer pit between them. The paint shop is 240½ x 265 ft. in plan and the passenger car shop, 240½ x 282½ ft. The transfer table runs on the rails of this pit and shifts cars from any track in one building to any other. The pit is 385 ft. in length and 80 ft. wide. The transfer table is carried on five rails spaced 19½ ft. on centers. Each rail is supported by longitudinal wood ties, resting on continuous concrete girders running the entire length of the pit and supported at equal intervals by single piles. The longitudinal reinforcing in the girders supporting the rails consisted of ⅝ and ¾-in. twisted square rods.

It was stated in the contract that four test piles were to be driven, tested to a specified load and excavated for inspection. This was accordingly done with results satisfactory to the railroad company, as reported in the Engineering Record of Nov. 30, 1912, page 607.



Section A-A

Section B-B

Foundation Plan

Detail of Lye Vat House

The entire foundation was built by the MacArthur Concrete Pile & Foundation Company, of New York City. F. L. Jenkins was superintendent. F. K. Irvin, special engineer for the Boston & Maine Railroad, was in charge of the work. Hunley Abbott, vice-president and chief engineer of the MacArthur company, inventor of the pedestal pile, collaborated with the engineers of the Boston & Maine Railroad in the design of these foundations.

Economies of Locomotive Cranes

Arguments to Show Why This Equipment Is a Good Six Per Cent Investment

WHO can afford to install a locomotive crane, and who cannot afford to do without one? According to Alex C. Brown, vice-president of the Brown Hoisting Machinery Company, in a paper presented June 8 before the Western Society of Engineers, a locomotive crane costing $7000 can be operated for $10 per day, including 6 per cent interest on the investment, depreciation and all cost of wages, fuel, lubrication and repairs. In other words, wherever there is work to be done in and about a plant which could be accomplished by a locomotive crane, and which, with hand labor, costs as much as $10 per day to accomplish, a locomotive crane is a good 6 per cent investment.

It is not a difficult matter for the manager of a coal yard, blast furnace, or lumber mill, and many other concerns handling materials in bulk, to figure fairly closely the possible savings to be made by a crane. Take, for instance, a company handling 800 tons of bulk materials per day at 10 cents per ton, or $80 per day. A locomotive crane could handle this tonnage in a ten-hour day for $10, or at the rate of 1¼ cents per ton—a saving of $70 per day. Such a concern obviously could not afford to defer the installation of a crane. A lumber mill handling an output of 100,000 ft. of lumber per day at 50 cents per thousand, could handle the same output with a locomotive crane at 10 cents per thousand, a saving of $40 per day.

ODD JOBS FOR CRANES

The nearer the crane can be operated to its maximum capacity, the larger the saving, but a crane does not have to be kept busy all the time to make its installation worth while. Given $10 worth of work or more to do per ten-hour day, and the price of a crane is well invested. A crane can effect so many economies that are difficult to calculate in advance that for the manager of a manufacturing plant, for instance, the saving to be accomplished with a crane is more difficult to determine than when bulk materials alone are to be considered. At such a plant the crane may unload coal for the power plant, dispose of the ashes, handle material to and from various departments, unload raw material, load finished product for shipment, and do all switching of cars. In many of these items and in the various other odd jobs that the crane should perform the saving in cost would be difficult to estimate in advance.

The saving in car demurrage alone enters in as a very material factor and is deserving of careful analysis. And now with the car-spotting charges of the railroads going into effect, an industry receiving carload shipments saves an additional $2 every time the locomotive crane switches a car. It is a safe rule, however, that if $10 worth of work per day is assured the crane is a paying investment and its idle time will be, in a large measure, employed with work that had not been calculated upon in advance. Furthermore, the installation of a crane is frequently desirable and almost necessary because of scarcity of labor, even though an actual saving in handling costs cannot be assured. In times of great business activity, a locomotive crane is excellent insurance against losses which would be occasioned by scarcity of labor or actual labor troubles.

Mississippi River Bridge at New Orleans

Legislating for Long-Span, High-Level Railroad Bridge with Piers on Soft Bottom

A BILL has recently been introduced in the Louisiana Legislature to give exclusive rights to E. L. Corthell and Arthur McGuirk for the construction of a railroad bridge across the Mississippi River at New Orleans and to prohibit all car transfers by ferries, barges or tugs after the bridge had been put in operation. The bridge and its income are to be exempt from taxation, and permission is to be given for the authorization of municipal taxes in aid of the bridge construction. The issuance of bridge bonds is to be authorized, and they are to be guaranteed to the extent of $6,000,000 by the State of Louisiana.

This bridge project had its inception in 1888, when the subject was investigated by Mr. Corthell as described by him in the Engineering Record of Sept. 24, 1906, page 569. Different sites were considered and one was finally selected at Twelve-Mile Point, and a charter was obtained in 1893. Financial conditions were such that construction was not undertaken at that time, although bids were received for it.

Further study of the subject resulted in the preparation of complete plans under the direction of E. H. Connor, now vice-president of the Missouri Valley Bridge & Iron Company. These plans, as described by Mr. Corthell in the Engineering Record of Dec. 1, 1906, page 611, provide for a double-track structure 2280 ft. long, with a clear height of 85 ft. above extreme high water. It has a channel cantilever span of 1066 ft. 8 in. and two 606-ft. 8-in. anchor arm spans with trusses 160 ft. deep and 40 ft. apart, made of medium carbon steel. The estimated weight of the entire superstructure is 23,700,000 lb. The river piers are 126 ft. high, contain 6600 yd. of masonry each, and are to have caisson foundations sunk by dredging to a depth of 70 ft. below the riverbed and 170 ft. below low water. The approaches are partly of steel spans and partly of timber trestles. The estimated cost was about $6,000,000, and it was calculated that the bridge could easily earn an income of 5 per cent on $13,600,000.

BATH HOUSES for live stock are to be built along the Baltimore & Ohio to eliminate a frequent source of offense to passengers' nostrils.

Book Reviews

The U. S. Geological Survey has issued the following water supply papers: 340A, 19 pages, "Stream-Gaging Stations and Publications Relating to Water Resources, 1885-1913—Part 1, North Atlantic Coast Drainage Basins," by B. D. Wood; 345A, 9 pages, "Preliminary Report on Ground Water for Irrigation in the Vicinity of Wichita, Kansas," by O. E. Meinzer; 345B, 13 pages, "Ground Water for Irrigation in the Vicinity of Enid, Oklahoma," by A. T. Schwennesen, with a note on "Ground Water for Irrigation on the Great Plains," by O. E. Meinzer; 345C, 16 pages, "Underground Water of Luna County, New Mexico," by N. H. Darton, with "Results of Pumping Tests," by A. T. Schwennesen; and 345D, 11 pages, "Ground Water for Irrigation in the Valley of North Fork of Canadian River near Oklahoma City, Oklahoma," by A. T. Schwennesen. The last three papers have inserts showing maps of the territories investigated.

AUFGABEN AUS DER TECHNISCHEN MECHANIK. By Von Ferdinand Wittenbauer, Professor in the Royal Technical Institute of Graz. Flexible cloth, 5½ x 8 in.; 323 pages; 610 illustrations; 816 problems. Berlin, Julius Springer. $1.50.

(Reviewed by Melvin L. Enger, Assistant Professor of Theoretical and Applied Mechanics, University of Illinois, Urbana.)

This book is one of three under the same title, the other two being problems in the strength of materials and in fluids and gases.

The volume being reviewed has 816 problems in analytical mechanics, profusely illustrated. The book is divided into five groups—forces and equilibrium, 391 problems; motion of a point, 98 problems; kinematics, 77 problems; dynamics, 223 problems, and dimensions, 27 problems. The field is very well covered, and the problems are so graded that the ordinary student will have no particular difficulty with most of them, but there are a few in each set which will tax the powers of the most brilliant student. Answers are given to all of the problems, and many of them are completely solved, the last 184 pages being used for this purpose. Problems requiring the use of calculus are indicated by an asterisk, about one-fifth being thus designated.

This is probably the best collection of problems in mechanics which has been published, and should be of great value to teachers of mechanics in American colleges. In schools where all students are required to study German this book offers a good opportunity for putting the knowledge of the language to practical use.

DESIGNING AND DETAILING OF SIMPLE STEEL STRUCTURES. By Clyde T. Morris, C.E., Professor of Structural Engineering, Ohio State University. Cloth, 6 x 9 in.; 260 pages; 94 illustrations. New York, McGraw-Hill Book Company, Inc. $2.25.

(Reviewed by F. H. Constant, Professor of Structural Engineering, University of Minnesota, Minneapolis.)

This book has received a very complete revision. Several of the chapters have been partly rewritten, about one-half of the diagrams have been redrawn and a number of new ones added. The most noticeable changes are the order of the chapters and the material increase in the size of the volume from about 200 to 260 pages. There is an entirely new chapter upon highway bridges, and an appendix containing the "General Specifications for Steel Highway Bridges, 1911, State Highway Department, Ohio." The order of chapters now reads: "Designing and Estimating," "Riveting," "Mill Buildings," "Plate-Girder Bridges," "Pin-Connected Bridges," "Details of Pin-Connected Bridges," "Highway Bridges," "Manufacture and Erection," "Appendix."

The work presupposes a knowledge of stresses in simple structures and co-ordinates with Professor Heller's "Stresses in Structures." Other references, however, are freely given in the footnotes. The book is intended as an elementary treatise upon design, adapted to the needs of the technical schools and the limited time usually available to them. Besides the descriptive matter and the brief exposition of theory, the subject is handled by the numerical computations of a representative example of each type.

The book is written in clear and simple style. It is greatly improved both in appearance and content by the revision, and is excellently suited to its purpose.

STEAM TURBINES. By James Ambrose Moyer, Professor in Charge of Department of Mechanical Engineering, Pennsylvania State College. Cloth, 6 x 9 in.; 376 pages; 225 illustrations. New York, John Wiley & Sons, Inc. $3.50 net.

Fifty-four pages have been inserted in the author's earlier work, and many of the others rewritten to accord with the rapid development of the turbine. The main changes have been in regard to the applications of the low-pressure and bleeder types of turbine. At the end of several chapters and in the appendix examples with answers have been added.

The book is well written and easily understood by the man who has a good knowledge of the action of steam, and for other readers there are chapters at the beginning of the book that give the necessary knowledge. The book is well adapted to class or reference work and has received a real revision.

DESCRIPTIVE GEOMETRY. PART I—LINES AND PLANES. By John C. Tracy, C.E., Assistant Professor of Structural Engineering, Sheffield Scientific School, Yale University. PART II—SOLIDS. By Herbert B. North, M.E., Assistant Professor of Drawing and Descriptive Geometry, Sheffield Scientific School, Yale University, and John C. Tracy, C.E. Cloth, 7½ x 10½ in.; 126 pages; 105 illustrations. New York, John Wiley & Sons, Inc. $2 net.

The contents of this book are divided into thirteen chapters, as follows: Points, straight lines, planes, summary of fundamental principles, three fundamental problems, problems in the point, line and plane, recapitulation of general methods, plane figures, solids, the development of surfaces, plane sections, lines and planes tangent to curved surfaces, and intersections of surfaces.

The importance is emphasized of the following four fundamental theorems into which the other theorems of descriptive geometry may be reduced: Finding traces of a line, revolution of a point about an axis perpendicular to a plane of projection, revolution of a point about an axis lying in a plane of projection, and finding the line of intersection of two planes. A special feature of the book is the three-column arrangement for the solution of the theorems, general method, special problems and special features. No original problems for the student are given in the text, but the authors state in the preface that a complete set of problems to accompany the text will be issued later.

As a whole, the work is clearly written and the illustrations are well chosen.

THE MICROSCOPY OF DRINKING WATER. By George Chandler Whipple, Gordon McKay Professor of Sanitary Engineering, Harvard University, and the Massachusetts Institute of Technology, with a Chapter on "The Use of the Microscope" by John W. M. Bunker, Ph.D. Cloth, 6 x 9 in.; 409 pages; 73 illustrations; 24 plates. New York, John Wiley & Sons, Inc. $4 net.

(Reviewed by George A. Johnson, New York City.)

In this third edition of Professor Whipple's book the entire subject of water biology has been brought up to date, and there is much new matter to be found in almost every chapter. Several new chapters have been added, among the more important being those on stripping of reservoir sites, copper treatment, purification of algæ-laden waters and the use of the microscope and photomicrography. The plates showing the more common organisms in water have been printed in colors, which adds materially to the value and appearance of the book.

For years Professor Whipple has been recognized as America's foremost biologist, and this latest edition of his book is only another demonstration of his pre-eminent ability in this field. To the biologist this volume cannot but prove of great value; to the student, a modern, condensed counterpart of Wollé; to the waterworks superintendent and chemist, a great helper in times of algæ troubles, and to the scientific world in general, a classic.

COMPRESSED AIR. By Theodore Simons, Professor of Mining Engineering, Montana State School of Mines. Cloth, 6 x 9 in.; 173 pages; 42 illustrations. New York, McGraw-Hill Book Company, Inc. $1.50 net.

This book is divided into four parts, taking up in more or less detail the following subjects: "Production of Compressed Air," "Transmission of Compressed Air," "Use of Compressed Air" and "Air Compression and Accessories." As can be readily appreciated, only a rather short treatment of the various subjects indicated is permissible. The idea of the author is apparently to use this as a textbook and to give the student in a simple and concise way an insight into the laws and principles ordinarily met. Included in the treatment may be found quite a few problems illustrative of the methods used, in addition to figures which indicate prominent types of machinery.

No space is given to fans or blowers, the entire work having reference to heavier pressures than are represented by these. The compressors are all of the reciprocating type.

In the back of the book may be found tables useful in calculations involving the flow of air in pipes, pressures and temperatures in compressors and other similar data.

The book is very limited in its treatment and is adaptable principally as a textbook, but then only when supplemented to a great extent by lectures.

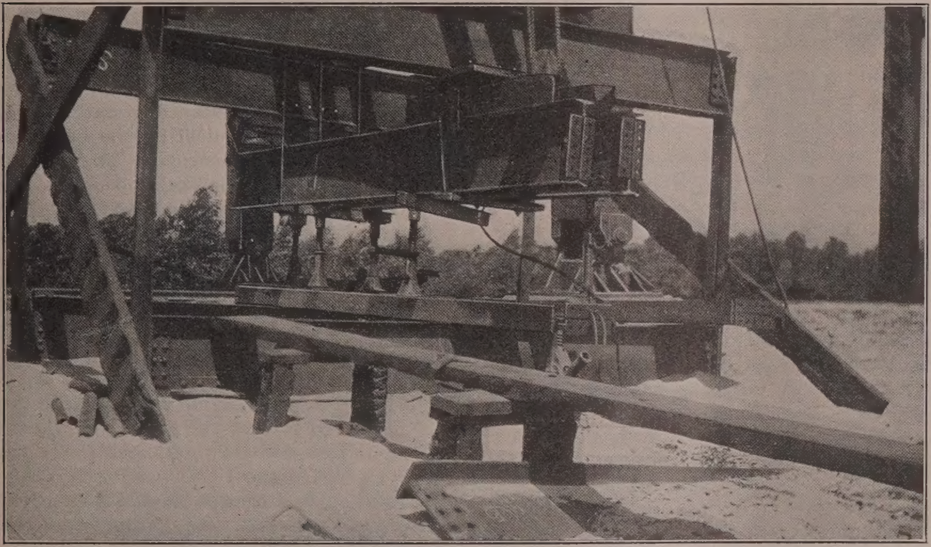
WATER CONSUMPTION in London, Ont., during 1913 was 92 imp. gal. per capita, according to the last annual report of the water commissioners of that city. Figured on pumping station expense the cost was 16.6 cents per 1,000,000 imp. gal. and 6.9 cents per 1,000,000 gal. raised 1 ft. About 84 per cent of the pumping is done electrically. The services now number 13,978, of which 2115 are metered. More than 450 meters were installed in 1913, against only 376 during the previous year.

Letters to the Editor

Repair of Fire-Damaged Floor System at Kansas City

Sir: Early last June a mysterious fire burned the timber decking and badly injured the steel work on the north approach of the Fratt Bridge. This fire lasted about thirteen hours, due to insufficient water facilities, and burned about 530 ft. of decking.

In the center of the north approach is a double-track electric railway and motorway with timber decking about 30 ft. clear between curbs. On either side and supported by cantilevers is a concrete-and-asphalt roadway about 13 ft. 6 in. clear. The center portion is supported by four lines of 20-in. 65-lb. I-beams about 15 ft. 6 in. on centers, and two lines of 9-in. channels at the curbs. Across these were laid 7 x 9 in. ties 2 ft. 3 in. on centers and supporting one layer of 3-in. plank running longitudinally and one of 2-in. plank running transversely. All timber was heavily treated with creosote and made a very hot fire.



Arrangement of Reaction Frame and Jacks for Strengthening Beams

The heat from the fire caused much more expansion in the viaduct members than could have been anticipated in the design, and at the expansion joint sheared 5 x 3½ x ⅜-in. stiffener angles to the root in eight places. It also caused about 90 per cent of the stringers to buckle and the rivets connecting the web of the 20-in. I-beams to the end connecting angles to shear, allowing the end of the beam to come hard up and flush with the connection where there had been a clearance of 3/16 in. In cooling, the viaduct contracted, and due to the shortened length the top flanges of the floorbeams each way from a thrust frame placed between the expansion joints were pulled out of line. The amount of this increased toward the expansion joint, where the floorbeam was 5¼ in. out of line. A rigid lateral bracing in the plane of the lower flanges of the floorbeams had the tendency to hold the bottoms of the floorbeams in line, and except in one or two instances proved very satisfactory.

The equipment used for repair consisted of a truck fitted with an A-frame and an electric drum hoist. On the same truck were placed an electric motor, compressor and tank, these forming a unit which could be moved into the most convenient position. Below on the ground there was a frame, used in straightening the stringers, which was built of laterals and stringers taken from the floor system and replaced when all of the stringers were straightened. The frame consisted of two 20-in. I-beams placed 8 ft. 6 in. apart on planks in the sand and directly over them two more beams supported by angle laterals as struts. From these were supported two beams placed 20 in. center to center, affording an abutment for jacking. The beam to be straightened was pulled out of the fire and laid flat across the lower I-beams and jacks were placed at points of vantage, taking out the kinks in both flanges simultaneously. About 100 beams were straightened in this manner at an average cost of about $6 each, or six-tenths of a cent per pound.

The floorbeams were straightened in place by using two 50-ton Norton jacks and jacking against a frame for an abutment. This frame was chained at the ends to the end connections of the floorbeam being straightened. As very few beams were bent in a uniform curve from end to end, it was necessary to use a pulling jack in addition to the Norton jacks to pull the beam in line. Interurban traffic was kept up on one of the two tracks, which made this straightening of the floorbeams a little difficult.

A concrete deck of the usual reinforced-concrete type supported by stringers is being laid to replace that portion destroyed by fire.

Lafayette, Ind. Charles W. Yelm.

Inadequate Specifications

Sir: Much has been published on the subject of specifications and their inadequacies and absurdities, yet the writer cannot refrain from sending the following excerpts from "specifications" for a bridge 102 ft. long in eastern Colorado, as given out to contractors for bidding purposes:

"Bridge to be a 50-ft. truss span with 26-ft. approach on each end.

"Truss span to be supported at each end by a pile bent consisting of five piling not less than 12 in. in diameter at top and 14 ft. long, to penetrate to solid footing.

"Bottom chord 50 ft. long, 12 x 12-in. clear timber, either Oregon fir or other timber equally as good. To be solid if possible, if not, to be spliced at center and carried from center of upper chord with suitable support.

"Truss to be of 12 x 10-in. timbers. Overhead chord to be 17½ ft. long and slanting chords 17½ ft. long. Overhead chord to be 9 ft. 7½ in. above top of bottom chord and supported at each end and center by upright pieces 6 x 6 in. x 9 ft. 7½ in. long. Lower chord to be carried from truss by two 1-in. iron rods from the joint at each end of upper chord with side chords and a support 12 x 10 in. x 18 ft. long under the bottom chord. Rods to have a saddle and burr on top and a 4 x 12-in. plate 1 in. thick and burr at the bottom."

Of course, a design and a bid can be worked out from the description given, but an intelligent canvass of bids by the county officials might prove to be a difficult matter. The low bidder might not necessarily be the best. However, this is quite the usual state of affairs on small public works.

And that it is not always on small work that this method is practised is evidenced by another specification herewith, that of a steel viaduct some 740 ft. in length. This is a work of some importance, inasmuch as it carries a roadway over two railroad yards and a small stream. The specification follows:

"1st. A profile drawing of the viaduct is herewith enclosed.

"2nd. The strain sheet shall be of sufficient strength and capacity to carry a live load of 100 lbs. per sq. ft., or a concentrated load of 15 tons road roller, 10 feet between axles.

"3rd. The distance to be spanned is 740 feet, including two approaches, one on the north end to be 120 feet and one on the south end to be 50 feet long. The approaches may be made of steel construction or with concrete spans, and floor, or with concrete retaining walls filled and tamped with earth, sand and gravel.

"4th. The roadway must be 24 feet 0 inches in the clear with a floor of either concrete, or 3 inches x 12 inches oak plank, with a sidewalk on one side of the roadway 5 feet 0 inches wide with a floor of 2 inches x 12 inches oak plank, with hand rail on the outside. The approximate length of the sidewalk 740 feet. The floor of the sidewalk shall be 8 inches above the floor of the roadway.

"5th. There shall be erected on each side of the viaduct at the edge of the roadway and in line with the inside railing of the sidewalk two pedestals or lamp posts, to be used for electric lights, making four in all.

"6th. The south end of the approach to the viaduct shall have a roadway for wagons to turn out, to be sustained by retaining walls, finished on top with either concrete or cut stone coping.

"7th. The steel work shall have two coats of durable paint, the color to be selected.

"8th. At station marked 3 + 15 on profile, shall be an iron stairway 6 feet wide, with hand rail on each side. On the riser of the top step a suitable tablet shall be placed, bearing these words

(Contractors.)

"Erected A. D. 1914, by............ .

"—— ——, —— ——, —— ——,

Committee.

"9th. Each contractor shall furnish his own plans and specifications, and be responsible for all measurements and calculations.

"10th. At the end of the north approach

entering —— Street shall be placed a concrete coping extending along the south side of —— street, with a suitable radius, a distance of 15 feet.

"11th. Contractors will be required to raise the north end of the present river bridge across the —— river on —— —— Street, approximately 5 feet and build a substantial abutment for sustaining the said bridge—and also provide suitable hangers for an 8 inch water main now supported by the said bridge. Said pipe line being the supply line of the town of —— ——.

"12th. The entire work shall be under the supervision of the undersigned executive committee, whose authority upon all matters of construction and materials used shall be absolute."

Here the bidder is given practically nothing on which to base a bid, but is blandly asked to furnish his own plans and specifications. The viaduct has both its approaches on grades, which are connected by a central portion on a vertical curve about 200 ft. long. The spacing of the supports is variable because of the arrangement of tracks, and the usual difficulties in the matter of longitudinal spacing are present, so that a special design is necessary. Nevertheless, the committee in charge, either to cover its ignorance or its parsimoniousness, asks the bidder to furnish costly engineering services free of charge on the chance of having his design accepted. And then only in case his design is cheaper and bid lower than that of some one else will he have an opportunity to be reimbursed for the time and money expended. The comparative merits of the designs will probably not be considered. It is very probable that the decision will be influenced by the relative sizes of the lettering on the tablet specified in paragraph 8.

Paragraph 12 is especially interesting as illustrative of the remarkably swift transformation from "butcher, baker and candlestick maker" to technical expert so common to American politicians the morning after election. The plumber becomes an expert on public health, or perhaps, finance; the grocer is an authority on waterworks and sewers, and the taxpayer becomes the goat."

There certainly should be some remedy for such a condition of affairs. Possibly a great deal of it could be remedied by the contractors in refusing to submit bids for work which was not fully covered by plans and specification. However, there always has been and always will be, no doubt, the small contractor who has his office in his hat and will furnish a plan for anything from a doghouse to a Panama Canal, if there is the slightest chance for making day wages. There are also the politician-contractors who "frame-up" the job in advance, give just enough information to keep legitimate contractors from bidding, and in many cases have the contract practically signed before the bids are opened.

These two types of contractors, of course, militate against the successful fighting for fair dealing by an association of legitimate contractors.

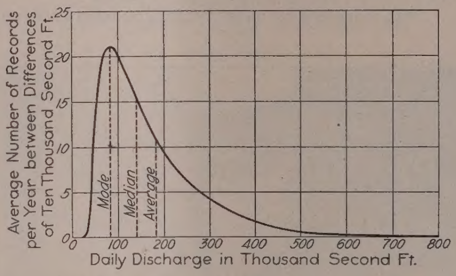
Colorado Springs, Colo. CONTRACTOR.

Ordinary Discharge of Rivers

SIR: I venture to draw attention to Robert E. Horton's interpretation of the term "ordinary stage or discharge" in his article entitled "Need for Simpler and More Definite Water Laws," published in Engineering Record of May 2, page 495. He writes: "Obviously it (the ordinary stage) can be nothing more or less than the most usual stage," and further: "The middle or median quantity will represent the ordinary stage or discharge . . . since the stream is just as likely to be higher as lower, and vice versa."

The adoption of the median as the ordinary stage is certainly a rational procedure, but I desire to point out that it is not "the most usual stage." The median stage lies somewhere between the most frequent, or "mode," as it is sometimes called, and the average, and its frequency may be considerably less than the maximum.

My point is illustrated by the accompanying diagram, showing the frequency curve of the Mississippi daily discharge at St. Louis, deduced from the duration curve on page 236 of the "Report on the Survey of the Mississippi River, 1909." It is formed by dividing the horizontal scale of daily discharge into sections of 10,000 sec.-ft., plotting over the middle of each the average number of records per annum occurring therein, and drawing a smooth curve through the points thus obtained. The mode is obviously at the peak, and since the area under the curve represents the total number of records, the median is at that ordinate which divides the area into two equal parts. The diagram shows clearly the relation between mode, median and average, and the difference between their frequencies. The frequency of the median is about 73 per cent and of the average 51 per cent of that of the mode.



Discharge of Mississippi River

In the case of streams subject to rapid and large fluctuations these frequency differences are even more accentuated than with the comparatively regular regime of the Mississippi at St. Louis.

D. HALTON THOMSON,
Chief Assistant to Engineer, Borough of Portsmouth Waterworks Company.
Portsmouth, England.

The War Against the Waves

SIR: Allow me to inform you that I read with great interest the article headed "The War Against the Waves," by Dr. Elmer L. Corthell, which appeared in your issue of April 11, 1914.

According to Dr. Corthell, "there is no valid reason why Seabright, N. J., and other points along our coasts may not be permanently protected, but it is useless to expect that a vertical-pile bulkhead with an unprotected foreshore in front in the sea is going to stand the stress and strain of heavy storms with their tremendous waves beating down all such frail protections and wrecking the property behind them."

In many instances low groins may solve the problem of efficiently protecting the shore, but whenever unusually strong undertow and lateral currents exist, with a rather steep slope of the beach, these groins are more or less exposed to be undermined on one side, whereas the sand level is even, or practically so, with the tops of the groins on the other side. Such a condition may cause, and in many instances did cause, the washing out of the groins during the stormy season. This occurred at Seabright, Seagate, L. I., Harbor and other coast resorts similarly protected, owing to the fact, apparently, that the slope of the sandy shore was too steep to insure the efficiency of the groins. It would greatly interest me to know whether or not it is possible efficiently and permanently to protect any sandy coast with a rather steep slope by means of ordinary groins.

In a case I have in mind the line of ordinary bulkhead to be protected is located about 25 ft. beyond the normal equinoctial high-tide mark, and several houses were built only 20 or 25 ft. back from the shore bulkhead—that is, "practically on Neptune's domain." Several low groins were already built according to the rules at right angles with the bulkhead, extending from same to low-water mark. Every winter some of these groins have been seriously damaged, or even washed out, so that their efficiency in this particular instance is rather problematic as far as protecting the beach and the bulkhead is concerned. They do not appear to check the lateral and littoral currents and those of ebb and flood tide so as to induce the undercurrents to work up material toward the shore, since at the end of the stormy season they are emerging several feet above the level of the sand, considerably more on one side than on the other. On the other hand, during the summer months the sand drifts cover them up almost entirely. They do not appear, either, efficiently to protect the bulkhead, which is more or less seriously damaged every winter. On Jan. 3 and 4 this was partly washed out and several houses located 25 or 30 ft. back were wrecked, while others were more or less damaged.

According to Chamberlain and Salisbury's "Geology," volume 1, page 32g, "Winter breakers which exert a pressure of 3 tons per square foot are not infrequent. The average force of the waves on the Atlantic Coast of Britain has been found to be 2086 lb. per square foot during the winter!" I can hardly believe that any bulkhead, even with a protected foreshore in front in the sea, could ever stand such a stress and strain of heavy storms.

The low groins and bulkhead extending from the Seagate bathhouse to the boat landing were completed in 1911. In 1912 much damage was done during the winter months. In December, 1913, and Jan. 3 and 4, 1914, at a point opposite the lighthouse, more than 2 acres of land are reported to have been submerged. The bulkhead and groins in front of the Seagate bathhouse were also wrecked. Under these circumstances I question the advisability of attempting to protect the shore at Seagate, unless the line of bulkhead is moved back about 35 ft. so that it should act simply as a wall of support for the sand behind, instead of being intended to protect the property against the encroachment of the ocean. Then, perhaps, low groins built at right angles with the bulkhead might be efficient, although the steepness of the slope will always have a tendency to interfere with the accumulation of sand to maintain the beach.

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